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Proceedings and Reports

— OF THE —

BELFAST NATURAL HISTORY AND PHILOSOPHICAL SOCIETY

— FOR THE —
SESSION 1934-1935.

EDITED BY
ARTHUR DEANE, F.R.S.E., M.R.I.A.,
HON. SECRETARY.

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[ESTABLISHED 1821.]

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The membership of the Society consists of Shareholders, Annual Subscribers and Honorary Members.

Shareholders holding more than two shares are not liable for an annual subscription, but shareholders of two shares pay an annual subscription of five shillings, and holders of one pay ten shillings.

In 1914 a new class of membership was created including persons of either sex, to be elected under the bye-laws of the Society, and admitted by the Council on payment of ten shillings per annum. Such members have all the privileges of the Society, and take part in any business of the Society not affecting the ownership of the property. In 1917 an Archæological Section was founded. Persons wishing to join the Section must be members of the Society and pay an additional minimum subscription of five shillings per annum.

A general meeting of Shareholders and Members is held annually to receive the Report of the Council and the Statement of Accounts for the preceding year ending 31st October, to elect members of Council, to replace those retiring by rotation or for other reasons and to transact any other business incidental to an Annual Meeting.

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Each member has the right of personal attendance at the ordinary lectures of the Society, and the privilege of introducing two friends for admission to such.

Any further information required may be obtained from the Hon. Secretary, at 7 College Square North, Belfast.

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[Please write name in full.]

Description

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....., being desirous of becoming a Member
of the Society, I, the undersigned member, recommend.....
as a suitable candidate for election.

Dated this.....day of....., 19.....

Signature of Member }

[Candidate must be known to the Member signing this form.]
[All applications are subject to the approval of the Council.]

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PROCEEDINGS OF THE BELFAST NATURAL HISTORY AND PHILOSOPHICAL SOCIETY. SESSION 1934-1935.

PRESIDENTIAL ADDRESS.

MECHANISM AND VITALISM.

RICHARD H. HUNTER, M.D., M.Ch., Ph.D.,
M.R.I.A., F.Z.S.

The processes by which a new life is produced have long interested men. From the earliest times theories have been advanced, based sometimes on the wildest speculation, but these were no sooner advanced than they were rejected and new theories brought forth. Of these theories that of the Predynastic Egyptians is of peculiar interest. These people lived and died in the Nile Valley, and every year they saw the floods come down and awake the parched and dry land to fruitful life. They watched, too, the land dry up and die, when the waters gradually returned to within the river bed. They saw the members of their families in death, shrivel in the hot dry sand and with a false, but logical, analogy believed that life had gone with the waters of the body, and that if these waters could be restored life would return to it, just as life returned to the parched land with the return of the river floods. These early people had unconsciously *reduced life to a physical basis*: that water was the essence of life, and without water life was not possible.

Throughout the ages other theories replaced this idea of life, and these theories, based on philosophical conceptions and theological reasonings, were in turn accepted as the true solution of the mystery, for men at all times are too readily deceived by fine words, and often mistake cunning phrases for answers.

It was not, however, until the invention of the microscope by Leeuwenhoek in 1673, that any scientific investigation of the problem was possible. By means of the microscope, minute forms of animal life were discovered, the existence of which had not even been suspected, and in 1688 Leeuwenhoek reported the discovery by Ham of the male sex cell called the sperm.

At first it was believed that the sperm contained a fully formed animal in miniature, and that the little animal developed by absorbing nourishment from the yolk of the female cell, the egg, to which it had become attached. This was known as the "preformation" theory. According to it all future generations were supposed to exist in the sperm cells of the parent.

The "preformation" theory was strongly combated by Wolf, who in 1759 tried to show that in the case of the chick the new life differentiated gradually from the unformed yolk substance, stimulated into life by the sperm. This theory was known as "epigenesis." It failed, however, to offer any explanation of *how* the sperm stimulated the egg into activity and growth, and even to-day there are two opposing schools of thought to explain the phenomenon: the Mechanistic and the Vitalistic.

Those who hold the Mechanistic theory look upon the living organism as a physico-chemical machine, relatively simple in structure, and controlled by definite physico-chemical forces acting from without. When thus acted upon, the machine itself is said to be subject to modification in structure, and when thus modified, its responses are also modified, that is, the machine is a different machine from which it was before modification, and must, therefore, respond in a different way to the external forces acting upon it. These reactions under definite internal and external conditions are, therefore, definite and predictable as in any other machine,

Those who hold the Vitalistic theory look upon the living organism as a machine to which has been added certain unknown factors, referred to as "vital processes." It is said to be controlled from within, although subject to certain external forces which act from without. The organism is thus said to be controlled by both known and unknown forces. The reactions of the living organism are said to be problematical and not predictable, because it is not, and cannot ever be possible to know all the factors involved in any response to outside stimulation, nor to know all the conditions which exist within the organism, and which constitute life.

The Vitalist believes that the unknown vital principle can never be explained. The Mechanist, on the other hand, believes that by patient study and research, all natural phenomena can be explained in terms of physics and chemistry, and by applying the newest discoveries in the laws and forces of physics and chemistry it will be possible to probe further and further into the so-called "vital principle," and finally to expose the innermost secrets of the laws which control growth, and the laws which govern life itself.

It is not, of course, suggested that the theory of Mechanism has so far been able to explain the essential properties of life, but it must be granted that at least it represents a positive attempt to find the explanation. This is the great difference between pure Mechanism and pure Vitalism, as the latter abandons all attempts to search for an explanation. The contrast between the two points has been clearly put by Raband (1923), who writes:

"Vitalistic reasoning is always departing from scientific reasoning, which represents a source of action. Though the man of science sees the complexity of the field which he is exploring, he does not allow himself to be disheartened by his task, but pushes on into the unknown like a pioneer in a virgin forest. The Vitalist, however, is content to believe: his faith satisfies him. Evading all work and effort, he finds gratification in imagining a world full of mysterious forces, which give birth to miracles."

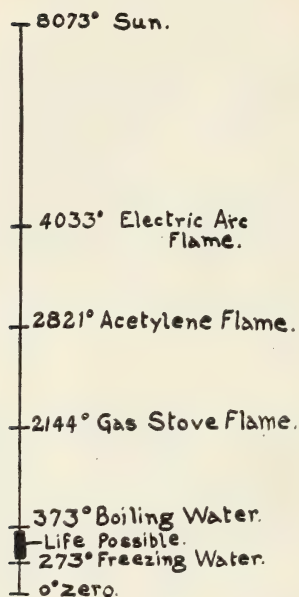


Fig. 1 (after Féry). Diagram of a thermometer scale reading from absolute zero to the sun's estimated temperature. It shows the limited temperature range in which life is possible.

Although all the positive facts concerned with the production of life are not quite clear, it is known that there are certain physical conditions under which life, as understood by us, is not possible. For example, it is not possible to have life at and below the freezing point of water, nor is it possible when the temperature approaches the boiling point of water (at sea level). This is because water is the chief single constituent of the living cell. It comprises more than 80 per cent. of all living matter, and through its aid the chemical and physical operations of the living substances are made possible.

Living matter is known only in what is termed the "colloidal condition," that is, a condition in which solutions of either organic or inorganic substances exhibit the properties of "gummy" substances, and which do not readily diffuse through animal and vegetable membranes.

There are two forms of the colloidal condition: the "sol" or solution, and the "gel" or jelly. These two, the sol and the gel, differ from each other in the degree

of freedom which the colloidal particles exhibit towards each other. Substances in the colloidal state may pass from the gel to the sol condition, and in the organic forms the change from sol to gel may be repeatedly reversible. That is, organic and animal forms may be at one time in the sol state, and presently change to the gel, and after a short time change back to sol, with power at a later period to change back to the gel once more. This reversibility of changes from sol to gel, and from gel to sol, is the chemical basis of the changes which follow the act of fertilization of the egg by the sperm, and which ends in cell division, and the production of a new animal life.

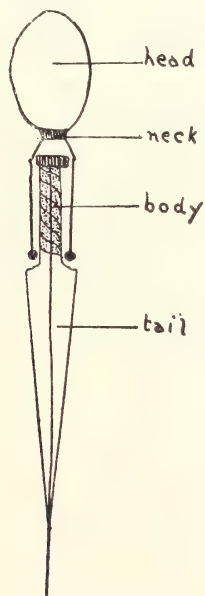


Fig. 2. Diagram of the male sex cell, the sperm, showing its constituent parts.

An egg of any kind, be it the egg of a worm, of a fish, of a rabbit, or of a human being, is a lifeless inert thing, and *in nature*, before it can begin the series of changes which end in the formation of a new animal life, it must first join and fuse with the second element derived from the male—the sperm. Each sperm consists of a nuclear mass, a head, a narrow neck portion, a body and a long

thin tail portion. It is by the active lashing of the tail that the sperm is enabled to swim towards the egg. The degree of this activity apparently depends on the chemical reaction of the fluid in which the sperms are placed. Cohn (1908) showed that the more alkaline the solution the greater the fertilizing power, provided that the alkalinity is not too great. He found also that acid solutions paralyse, or even kill the sperms outright. He found, too, that the sperms in concentrated suspensions live longer than those in dilute solutions. This is because the more concentrated the suspension, the carbonic acid given off by the sperms, and which lessens the alkalinity of the fluid, in turn decreases the activity of the sperms, and as a result their lives are increased in length. Measurements of the total carbonic acid production of sperm suspensions of varying concentration show that sperms which live 24 hours produce the same amount as those which live only 4 hours. Sperms, therefore, which have been in fluid more alkaline than normal have a more potent fertilizing power than normal, but for a shorter time; while sperms in fluid more acid than normal are correspondingly inactive, but retain the power of fertilization for a much longer period. From these facts it is clear that external chemical influences are involved in the act of fertilization, facts which might be used in support of the Mechanistic theory of life.



Fig. 3. Diagrams to show the changes in the chromatic material of the cell from the diffuse nuclear mass, through a spireme-like stage, to division into the short rods known as chromosomes, and their subsequent collection into two groups to form two new nuclei, for two new cells.

Before fertilization of the egg (the ovum) by the sperm can take place, changes must take place in the essential part of each, the nucleus, whereby its chemical content is reduced in amount. These changes involve the part known as the "chromatin," which undergoes a series of alterations in form, from a diffuse mass, through a thread-like spireme which in turn divides into short rod-like structures called chromosomes. The chromosomes are constant in number for the sex-cells of any given species. They may number as few as two in each nucleus, as in the round worm "*Ascaris megalocephala univaleus*," and as many as 168 as in *Artemia*. In man they number 48. But for purposes of description a theoretical germ cell in which there are six chromosomes has been taken four ordinary chromosomes and two special chromosomes.

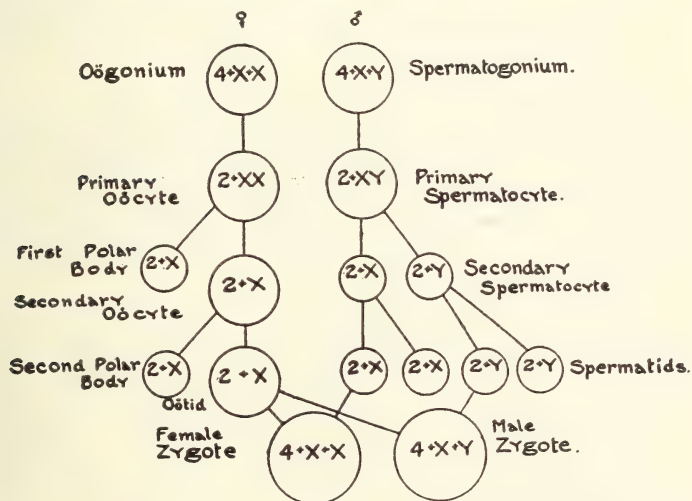


Fig. 4. Scheme to show the changes which occur in maturation of the sex cells, ova and sperms.

The germ cell undergoes a number of divisions and at the same time casting off two of the ordinary and one of the special chromosomes. (In the female germ cell the special chromosomes are known as the X-chromosomes, and in the male germ cell as the X-chromosome and the Y-chromosome). In the female cell the result of the

divisions is the formation of one large mature egg-cell in which there are two ordinary, and one special or X-chromosome. The balance of the chromosomes having been cast off and not used. In the male germ cell the result of the divisions is the formation of four mature cells, or sperms, two of which contain two ordinary and one special or X-chromosome, and two containing two ordinary and one special or Y-chromosome (Fig. 4.). Any one of these mature sperm cells is now ready to fuse with a mature egg cell, in the act of fertilization.

It has long been known that there is a definite relation between the special chromosomes and the sex of the future embryo. When a sperm with an X-chromosome fertilizes an egg, the resultant embryo is a female, but a sperm which contains a Y-chromosome, will on fertilization of an ovum, produce a male embryo. The reason for the result is obscure, but whatever it is there seems no doubt but that it is a chemical one.

The scheme shown in fig. 4 shows the changes in the chromosomes during the period of preparation, or maturation as it is termed, for the act of fertilization. The chromosomes are reduced to half their original number, so that after fertilization has occurred the fertilized egg, known as a zygote, possesses the number of chromosomes typical for the adult of the particular species.

In certain forms of animal life the egg substance is pigmented, and differentiated into definite zones. For example, in the sea-urchin there are three distinct zones: a broad middle zone in which most of the pigment is concentrated; an upper greyish-coloured zone, and a lower zone of rather clearer material. These three zones form the foundation place of the new embryo-animal. The upper grey-coloured zone produces the outer covering and the sense organ of the young sea-urchin. The middle zone produces the lining of the primitive alimentary canal, and the lower clear zone produces the skeleton and other tissues lying between the inner and the outer layers of the animal body. If any of these zones of material is removed or disarranged, there is a corresponding abnormality in the developed parts of the later animal. A similar process has been described by Conklin in *Crepidula*. The ground plan of the embryo is thus laid down in the egg at a stage before

fertilization has taken place. The Mechanist holds that these zones, being chemical in differentiation, support his view that physico-chemical forces are at work. The Vitalist holds that these zones, even if they are chemical in nature, support his view, that they have been laid down, predestined to form specific parts of the animal long before any outside influence is at work; laid down by a vital force over which no physico-chemical laws have control.

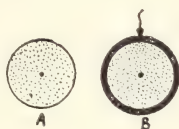


Fig. 5. Diagrams to illustrate the change in the form of the egg before and after the sperm has become attached to it. A, before sperm is attached. B, after sperm is attached.

The first observable change in the act of fertilization is the appearance of what is known as the "fertilization membrane." The mature unfertilized egg appears to be surrounded by a single membrane, but as soon as the sperm attaches itself to the egg, two distinct membranes appear, separated from each other by a narrow interval. The origin of the membrane, and the mechanism involved in bringing it into prominence, has caused considerable discussion. These are of an involved physico-chemical nature, and without a fair knowledge of the laws which govern the transmission of fluids through animal membranes, are not readily followed, the details of these arguments will not be discussed. There are, however, a number of experiments which have a direct bearing on the question, and which are readily understood. The first of these is that of Just of Chicago, who caused the elevation of the "fertilization" membrane in sea-urchin eggs by the simple experiment of placing them for a short time in hypertonic sea-water, without the aid of sperms. He showed further that these eggs underwent the typical changes and divisions which follow natural fertilization by sperms, and that they developed into free swimming young sea-urchins. These experiments of Just have been repeated and confirmed, and they are said to show beyond any shadow of doubt that this phase of fertilization is a chemical one.

These early changes in fertilization occur so rapidly that it is difficult to follow them. But after an extensive series of observations Lillie of Chicago found that in *Nereis* (a round worm) the sperm penetrates slowly, and that the final penetration does not occur until about three-quarters of an hour after insemination. Eggs of this worm were placed in a dilute solution of Black Indian Ink, and sperms were then added to the solutions. It was then seen that as soon as one of the sperms attached itself to an egg, some substance flowed out from the egg, washing the Indian Ink and the unwanted sperms away, and leaving a clear area of this substance around the egg. When this had occurred, the fertilization membrane was then clearly seen.

Soon after the formation of the fertilization membrane, a transparent "fertilization cone" arises from the cytoplasm of the egg at a point opposite the attached sperm. The cone rises and crosses the space below the membrane and comes into contact with it at the point of attachment of the sperm. In fixed and stained preparations the area of the cone can be seen as a modified area of cytoplasm of a higher refractive index than that of the remainder of the cytoplasm.



Fig. 6. Diagrams to illustrate the changes which occur in the egg during the act of penetration of the sperm.

The further changes in the act of fertilization are shown diagrammatically in fig. 6. The head of the sperm, which looks like a tiny tadpole, pierces the egg membrane and becomes, as it were, sucked into the cytoplasm of the egg, by the gradual flattening of the cone.



Fig. 7. Diagrams to illustrate the changes which occur in the egg immediately after penetration of the sperm.

The head of the sperm then rotates around a transverse axis of 180 degrees, so that its base, which is directed in an external direction immediately after entrance, becomes orientated towards the centre of the egg (fig. 7). This rotation is associated with the development of a structure known as the "sperm aster" and of a centrosome which arises at the base of the sperm head.

The sperm head, now known as the male pro-nucleus, comes closer to the egg nucleus, and the chromatic material of the two nuclei becomes vesiculated. The sperm aster divides and forms two asters, and the nuclear membranes break down and disappear. The chromatin of each pronucleus now forms a spireme, and the two approach each other, guided by the rays of the spindle connecting the two asters. The chromatin now breaks up into its constituent chromosomes, these meet and fuse, and the male and female elements are joined to form a single unit, from which two groups of chromosomes separate, each of which contains equal parts of both male and female nuclei. A subdivision of egg cytoplasm then occurs, and where there was one cell, two appear.

This is the beginning of the series of divisions which result in the formation of a new individual.

The fertilized egg divides because of certain qualitative nucleo-plasmic relations in the cell. These are in the nature of a chemical reaction, precipitated by rhythmical changes of permeability of the nuclear membrane, induced by the presence of the sperm. It is on account of this absence, or at least of the slowness of such interaction between nucleus and cytoplasm, that the unfertilized egg is inhibited from development. The internal function of the sperm in development is to restore the condition of active from inactive interaction between nucleus and cytoplasm. Aster formation and nuclear changes are evidences of such restoration. The sperm nucleus and egg cytoplasm, are

immediately capable of union, and as the fertilization proceeds, the egg nucleus is drawn into it. From a consideration of the above facts, the following conclusion may be drawn: In both the sperm and the egg cell, as a result of maturation, the capacity for the nucleo-plasmic interaction necessary for constructive metabolism has been lost. But such interaction takes place between the sperm nucleus and the egg cytoplasm, and this interaction initiates the internal phenomenon of fertilization. The egg nucleus is drawn into this phenomenon in one of two possible ways: The sperm nucleus may so alter the egg cytoplasm that reaction between the egg nucleus and its own cytoplasm can follow, or that fusion of the germ nuclei may result in a change of the egg nucleus that restores its capacity for the necessary nucleo-plasmic reaction.

Ziegler (1898), by constricting fertilized eggs of the sea-urchin between the two germ nuclei so that fusion of the latter was prevented, showed that the egg nucleus becomes surrounded by cytoplasmic radiations which rhythmically appear and disappear synchronously with this disappearance and reappearance of the nuclear membranes. This observation indicates a change by the sperm nucleus throughout the egg cytoplasm, which in turn induces a partial series of the rhythmical changes of successive mitotic divisions. It also indicates that the egg nucleus only reacts incompletely to the egg cytoplasm, when altered by the sperm. It would seem that fusion of the germ nuclei also involves a further interaction between them, and that this interaction completes the fertilization phenomenon. It is interesting to note that if the sperm head is removed from the cytoplasm before fusion with the egg nucleus, the chromosomes which differentiate from the egg nucleus are not set free in the cytoplasm, as they are when fusion is allowed to take place. In these changes only fully developed eggs are capable of fertilization. The reason for this fact is not difficult to understand, if it is remembered that the first step in fertilization is the binding, or agglutination of the sperm to the egg. It can be shown that the agglutinating substance appears to be the product of the egg. For example, if ripe eggs of *Arbacia* are washed in sea-water until they no longer give the agglutinating reaction, they become incapable of being fertilized, and during the washing process loss of capacity for fertilization

runs parallel to the loss of agglutinating substance. This fact can be shown to be true for all marine forms of animal life.

The agglutinating substance is a chemical one, and it acts, further, as an activating substance to cause the division of the egg after fertilization is completed.

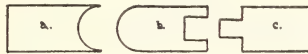


Fig. 8. Diagram to illustrate the intermediary action of the agglutinating substance. "A" the sperm, "B" the agglutinating substance, "C" the egg.

The agglutinating substance is thought to act as an intermediary. That is, the egg substance and the sperm cannot by themselves unite, and that they require a third substance as a connector to link them together. This may be considered to occur in a similar manner to the connector element of Erlich's theory of Immunity. The egg substance represents Erlich's antigen, the sperm substance the complement, and the agglutinating substance the amboceptor. Fig. 8 shows in diagrammatic form this intermediary action of the agglutinating substance.

It must not be supposed that when an egg and a sperm come into contact that fertilization must necessarily occur. Certain conditions are necessary, one of which has been shown by Jacques Loeb (1904) to depend on the reaction of the fluid in which they lie.

Fertilization will occur in solutions which are neither too strongly acid nor too strongly alkaline. It has been shown by different observers since Loeb that the range of acidity through which normal fertilization can take place is very limited. For example, if the percentage of eggs fertilized in waters of different acidities be plotted against the acid values of the waters, the resultant curve will be seen to be almost symmetrical. The curve rises rapidly from zero to a point where practically all the eggs are fertilized, and falls again to zero.

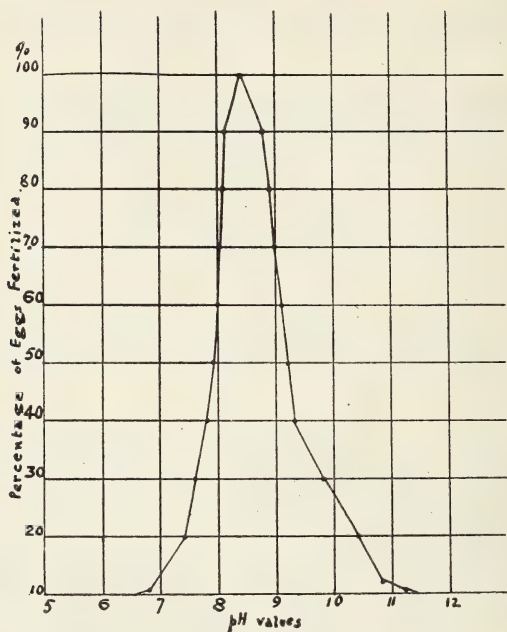


Fig. 9. In this graf, the percentage of eggs of *Arbacia* fertilized is plotted against the acidity (pH.) of the water in which the eggs and sperms were placed.

Many other facts of a physico-chemical nature are known to occur during and immediately after the act of fertilization. There is a measurable increase in the rate of oxidation of the fertilized egg, from 400 to 600 per cent. above that of the unfertilized egg. There is also an increase in the rate of heat production at the time of fertilization corresponding to the period when the increase of oxidation occurs. By the aid of very delicate thermophiles, a vacuum flask, Rogers and Coll (1927) were able to make measurements of such accuracy as to be able to show that unfertilized eggs give off heat at the rate of 0.08 calorie or heat units per million eggs. This rate of heat production almost at once begins to fall in about 20 minutes after fertilization.

Then, too, it is known that the division of the nucleus of the fertilized egg involves the production of phosphoric acid, and this acid, according to Robertson (1926) is produced during nuclear changes from lecithin, which is contained in the nucleus.



Fig. 10. Diagram to illustrate the supposed manner of cell division.

The two sub-nuclei, after division, pass to opposite poles of the egg, and there they each give off a substance known as choline. This substance diffuses equally in all directions, and therefore its maximal concentration will be in the equatorial plane at right angles to the line which joins the two nuclei. It is in this plane that division of the cell occurs. Now, it is known that if choline be applied experimentally to the diameter of a drop of liquid immiscible with water (provided a soap is formed) the result is a division of the drop along that diameter. It is therefore thought that the choline set free in nuclear synthesis brings about the division of the cell in a similar manner through the formation of soaps in the equatorial plane.

The streaming of the cytoplasm from the equator of the cell, and which brings about its division, suggests that the phenomenon antecedent to the division may be the result of, or caused by, a diminution of surface tension in the equatorial plane. Such a division may be brought about experimentally with a thread steeped in sodium hydroxal. The thread is placed in contact with a drop of oil, currents are at once induced within the drop, and these flow in a direction away from the point of contact, and the drop separates into two smaller drops.

This, to all appearances, is exactly what happens in sub-division of the cell, only the chemical substance or substances which cause the currents to be set up are produced within the cell itself by the activity of the nucleus.

In past discussions between Mechanists and Vitalists, the latter constantly stated that the former were unable to

create life. This taunt induced the Mechanists to try and produce life where none had existed before. One of the earliest experiments with this object in view was the attempt to set life in motion in unfertilized eggs. Meade (1897) was one of the first workers to perform experiments of this nature. He found that if unfertilized eggs of *Chaetopterus* be placed in sea-water to which one half to one per cent. of sodium chloride has been added, that the eggs undergo the first stages of development in their internal structure.

Two years later, Morgan of California carried this experiment to a further stage. He treated eggs of *Arbacia* with sea-water to which magnesium chloride had been added, and found that unfertilized eggs, after treatment with this fluid, developed the internal changes of fertilization, and then proceeded to divide and form two cells, and then died. Morgan then changed the proportions of the chemical contents of sea-water, and he found that by adding to it both magnesium chloride and sodium chloride that the eggs proceeded to still further changes of development before death.

At the same time as Morgan was conducting these experiments, Bataillon was working independently on similar lines with frog's eggs. He found that by treating these eggs with a solution of salt and sugar that division of the egg could be induced, and the first stages of development be brought about before death occurred.

Many further experiments were carried out, but it was not until 1908 Loeb discovered that if eggs of the sea-urchin be treated with any of the mono-basic fatty acids, such as formic, acetic, propionic, butyric, valerianic, etc., that development could be initiated, and that these unfertilized eggs proceeded to the formation of apparently normal larvae. These fatty acids all produce in the unfertilized eggs a superficial cytolysis which, Loeb stated, caused the formation of the fertilization membrane. But superficial cytolysis tends to bring about the death of the egg, and a corrective treatment was found in the normal sea-water into which the eggs were placed after treatment with the fatty acid. Loeb concluded from these experiments that the sperm carries a lysin which initiates a superficial cytolysis of the egg; and the first effect of the sperm on the egg is thus comparable with the action of butyric or other fatty acid,

Guyer (1907) showed that frog's eggs could be activated into life by pricking them with a fine pointed capillary tube *provided* that it had previously been charged with lymph from the blood of another frog.

These experiments were a direct attempt to try and discover the nature of the chemical changes induced in the egg on fertilization, and although the results prove that parthenogenesis can be brought about by the exhibition of certain chemicals, and that when it is once begun the chain of vital processes continues. But the nature of these processes, physical, chemical or vital, is not explained.

Another question which arises from a study of these experiments is the fate of the parthenogenetic embryos. Loeb states that he succeeded in raising 21 parthenogenic frogs through metamorphosis from the tadpole stage. Of these 15 were males, 3 females, and 3 indeterminate. Later he reared 65 parthenogenic tadpoles to the fully developed frog stage.

It is thus clear, from the results of the above experiments, that at least in the case of the frog, that the unfertilized eggs can be activated by chemical substances, and that these can be reared to adult frogs without the assistance of the male sperm cells.

Another set of experiments which is said to support the Mechanist in his views is that associated with the transmission of acquired characters. There is no doubt that acquired characters can be transmitted from parent to offspring, and that this transmission is brought about through the agency of the chromosomes of the nucleus of both male and female sex cells. Unfortunately knowledge of this material and of its structure is of the scantiest, in spite of the enormous amount of study already given to it. But enough is known of its behaviour and microscopic characters, and of the number, size, shape, staining reactions and behaviour of the chromosomes which separate out from it during mitosis, to give the impression that there are chemical differences in different parts of the chromatic material of the separate cells of any individual and of different species, and that there are even differences in the different parts of each individual chromosome. There is evidence also that these differences occupy definite positions both in the chromosomes and in

the spireme of chromatic material from which the latter form, and that these chemically different parts are the determiners of the specific characters transmitted from parent to offspring. These points of chemical differences have been called "genes," and it has been shown by Morgan and others that any change in the form and position of any one of the genes will effect the character of the offspring. Such changes are referred to as mutations, and the gene, once fixed in the changed condition, remains fixed until it mutates again, and this again produces a change in some character of the next generation. The fact of the mutations is so clear that Morgan and his co-workers have mapped the position of 125 or more independent characters upon the four chromosomes of *Drosophila*. These facts show that the transmission of hereditary characters involves, as its instrument, the use of a well-established chemical framework. The precise way in which differing characters are transmitted is of considerable interest, and although details of the method used in the transmission of hereditary characters are not entirely understood, a good deal is known of the results of crossing various species with one another, and of the laws which govern the results. For example, caterpillars of the silk-worm moth (*Bombyx mori*) show racial differences, especially in their colours and markings, some being a simple pale colour and others striped. Toyama (1906) crossed these two species, and the resulting caterpillars were striped. These were reared and the moths inbred, and the result was a mixed set of caterpillars in the proportion of three striped to one pale. The two types of caterpillars differed from each other by one factor difference, and the results were like those found in Mendel's classical experiments with peas. When yellow peas were crossed with green peas the green characteristics disappeared in the first generation and reappeared again in the second generation, in the proportion of three yellow to one green. The green and the yellow colours are what is known as "unit characters," and the unit character which disappears in certain generations is called the "dominant." This proportion of three dominants to one recessive in the grandchildren is the most characteristic feature of what is called the Mendelian Law, the inheritance of unit characters. Further study by hundreds of investigators

showed that great numbers of characteristics in all sorts of living things follow the same law. The experiments of Loyana follow this law. They are explicable on the assumption that in the germ plasm of the hybrid, the element for striped (that came from one parent) separated from the element for pale (which came from the other parent). Half the eggs of such a hybrid would contain the striped element, and half that for the pale. In the same way, in the case of the male hybrid, half the sperms would carry the element for the striped and half for the pale. The meeting of an egg of such a sperm would give one pure striped to two hybrid striped and one pure pale, that is, three striped and one pure pale.

It has long been the custom to state that these inherited characters are transmitted through certain cells, which have been separated off from the germinal somatic cells of the body, and retain their isolation right from the beginning. These isolated cells are known as the "germ cells," and from them the sex cells are believed to be developed. This theory was first formed by Weismann (1891) who, as a result of a long series of observations on the histological characters and on the development of the sex cells of Hydromedusae, postulated what is known as the theory of the continuity of the germ plasm. By means of this law he taught that acquired characters could be transmitted from one generation to another. He said: "In every ontogeny and part of the specific germ plasm contained in the parent cell is not used up in the construction of the body of the offspring, but is reserved unchanged for the formation of the germ cells of the following generation."

To-day biologists are by no means agreed in accepting this theory. The lateness of the appearance of the germ cells in the development of most animal forms is in itself suspicious. In Hydroids, for example, they do not appear until the adult stage, and then their origin is from the cells of the body wall which is already differentiated.

Then again, it is known since the work of Harrison and Garrett (1926) that if the larvae of certain moths be given food contaminated with manganese chloride, melanism will be induced in the adult, and that this induced melanism is inherited in the offspring according to Mendelian laws. In this case a chemical agent has

affected both the body and the sex cells, and the influence exercised on the sex cells is such that it causes the induced character to be passed to the future generation. Harrison has shown that in the common white butterfly the green colouration which can be induced by exposure to yellow light is also transmitted to future generations living in ordinary light.

An even more interesting series of experiments has been performed by Sonneborn (1930) on the effects of lead acetate on the hereditary constitution of *Stenostomum incaudatum*. This worker found that when single individuals of *stenostomum* were subjected to a standard solution of lead acetate throughout their lives little or no effects were observed. But when lines composed of successive first offspring were subjected to the same concentration of lead acetate, all lines became abnormal in structure in less than ten generations. Many of these structurally abnormal individuals survived when removed permanently from the lead acetate. Their abnormalities in some cases underwent regulation, but in other cases they were transmitted to offspring and gave rise to a new race with constant structural characters, proving beyond any shadow of doubt that the sex cells had been changed in the adult by the action of certain chemicals.

So far this discussion has been confined to the sex cells, and to the physico-chemical factors which appear to influence them. Another point of view, however, must be considered before attempting to weigh in the balance the evidences for and against the two opposing theories of Mechanism and Vitalism.

After the act of fertilization is completed and the egg divides, the resulting cells continue to divide and arrange themselves in an orderly manner until they eventually form an embryo of the animal from which the egg was obtained. These divisions follow a definite order, and successfully form a two-cell stage, a four-cell stage, an eight-cell stage, and so on, until a solid mass of many cells is formed. These cells then differentiate into two groups, an outer protecting group and an inner solid mass from which the embryo itself develops.

From the solid mass of cells, three distinct subdivisions of cells differentiate, which are distinguishable from one another by their microscopic characters. From

each of these groups of cells specific tissues and organs are formed. No matter what animal is concerned, these three layers always differentiate and normally they always develop along certain definite and predictable lines towards the formation of the different parts of the embryo of the species from which the original egg and sperm were obtained. These changes are very gradually brought about, but always the change is specifically directed towards a definite objective. If at an early stage any specific clump of cells is transmitted to a different part of another embryo, or even to another part of the same embryo, that clump of cells goes on changing to form the organ and tissue for which it was primarily intended, long before it was needed for that particular function.

The eye is one of the first organs to differentiate, and in an early embryo is one of the most characteristic things. The heart develops and is a formed organ which shows rhythmical contractions long before the blood is formed on which the heart can act. The lungs, too, are developed at an early stage, long before they are needed to function as respiratory organs.

Each and every organ in the body is laid down from the beginning, and no chemical or other physical force can alter it from developing into that particular organ for which it was intended and for which it was laid down while the embryo consisted of little more than a mass of more or less indifferent cells. Physical forces can only kill these cells, they cannot alter their course once it has been laid down.

Facts such as these all are in support of the Vitalistic concept of life, and are in marked contrast from the facts of fertilization which so strongly support the Mechanistic theory. To which view then should one incline? Is a purely Mechanistic explanation for the beginning of a new life to be accepted, or can it be postulated that there is within each germ cell a something which is called a "vital principle" which is not capable of any physical explanation and which is responsible for the development of the new individual?

Such questions are, in the present state of knowledge, well nigh impossible to answer. The series of changes in the form and position of groups of cells which precedes the formation of definite tissues and organs seems to suggest

that a "vital process" is at work guiding and controlling these changes towards a definite object. Whilst the demonstrable facts concerned in the act of fertilization, of parthenogenesis, and of the chemical changes which are known to occur in the dividing cell, all point to the Mechanistic view.

It would appear, however, that from the beginning development moves along a prearranged pathway which ends in a predestined goal. Chemical changes occur in the cytoplasm of the cell in a regular and orderly sequence, each change leading to a definite and predictable result. The division of the cell into two cells. The secondary cells, so formed, in turn go through similar changes, and a clump of cells is brought into being. The cells of the clump then arrange themselves in groups and masses, and these presently differentiate into definite tissues and organs. The organs are laid down apparently under the influence of some force inherent in the cells which form them, in anticipation of the needs of the future individuals, long before these organs can come into relation with the needed stimuli which cause them to begin the function for which they have been prepared.

In the development of the eye, the retina with its constituent cells; the lens with its ciliary-processes and muscles which alter its focal length at will, and permit of distant and near vision; the cornea and the vitreous humor, each and every part develops for the purpose of vision, long before the central connections with the brain are developed.

The heart tube develops and shows rhythmical contractions long before there is any trace of a blood stream (Polten, 1931). The heart had developed and prepared itself to perform the functions of a "pump," in anticipation of the future needs of the fully developed animal.

So, too, with the lungs. These develop at an early stage, and months before they are required to expand with the first inspiration after birth they are formed in every particular, ready for the stimulus which prompts the act of breathing.

The needs of the fully formed animal are anticipated from the moment of fertilization, from the very beginning, and preparation is made to have these needs supplied as

they arise. Facts such as these have led many thinkers to question the adequacy of the Mechanistic theory, but in view of the results obtained in the many experiments of a purely physical nature few workers have been able to accept completely the alternative theory of Vitalism. The changes demonstrated in the cytoplasm of the egg immediately after fertilization are purely physical, and the fact that these changes can be produced, in the unfertilized egg, after treatment with certain chemical agents, with the formation of apparently normal living animals, in such widely different forms as invertebrate sea-urchins, and vertebrate frogs make it impossible to lay completely aside the claims of those who support the Mechanistic theory.

Is it possible that there is a middle view? Can it be assumed that the physico-chemical processes demonstrable within the organism are merely the means whereby the latter develops, grows, and functions? If this is so, then the physical processes merely represent an outward and visible manifestation of the suggested vital principle. The study of the living organism with its ordered sequence of changes, the elevation of the fertilization membrane, the appearance of the centrosome, the mitotic figures, and the division of nucleus and cytoplasm, would seem to indicate a co-ordination or control of the physico-chemical processes, and to offer support to the Vitalistic view.

Throughout the changes there appears to be a purposeful activity, an orderly sequence of events towards a definite object. Every cell of every embryo shows this purposefulness, in the way the individual cells arrange themselves into groups before differentiating into definite organs.

"If we watch the development of an animal," writes Johnston (1904), "into a larval form, and continue to trace the use to morphosis of the larva into its perfect form, we cannot fail to conclude that beside the individual physico-chemical reactions which precede these changes there is also organisation. The elementary processes must be integrated. There must be a due order and succession in them. In studying developmental processes, in considering the developing organism as a whole, we are impressed above all else with the notion that not only do physico-chemical reactions occur, but that these are marshalled into place."

This purposefulness is weighty evidence in support of the Vitalist, and that there are present in the sex-cells

certain unknown—shall we say vital?—factors which marshall the cytoplasmic elements along a predestined pathway, with a definite purpose always ahead of them. The search for the physical factors involved in this purposefulness elude the investigator at every turn. He probes deeper and deeper into the physical and chemical processes of living cells, and he exposes one fact after another, of the physical changes through which the egg cell passes in its development to an embryo, to a young animal, to a new life. He proves beyond all reasonable doubt that each of these changes are associated with certain physico-chemical activities, but always the apparently purposeful factor, the vital force, eludes him. Yet, although this is so, he keeps following this elusive factor in the hope that some day it may be revealed to him. He seeks an explanation for the last discovery, and when this in turn has been brought within the known laws of physics and chemistry, he sets out once more to probe into this new mystery, to reduce it to a physical basis.

Is it that this search is like setting out to find the end of the rainbow? That he will never reach the end of his journey? This, however, instead of discouraging him, merely stimulates him to greater effort, with each advance a new line of attack is opened out to him, and vital phenomena of yesterday are revealed to-day in the cold formula of chemistry, obeying the fixed laws of the physical world. The investigator's studies may never end, an elusive vital factor may always confront him, and at last he may be obliged to acknowledge the presence of a "vital principle" that is beyond the ordinary laws of the physical world.

11th December, 1934.

Dr. R. H. Hunter, President, in the Chair.

CAPTAIN H. PLUNKET WOODGATE.

“ MODERN GERMANY THROUGH BRITISH EYES.”

Slides.

[No Abstract.]

8th January, 1935.

The President in the Chair.

THE EARL OF ANTRIM.

“ A JOURNEY IN PERSIA.”

[No Abstract.]

15th January, 1935.

The President in the Chair.

DR. THOMAS BODKIN, M.R.I.A.

“ JAMES BARRY AND GEORGE BARRETT: TWO
IRISH MEMBERS OF SIR JOSHUA REYNOLD'S
ACADEMY.”

Slides.

[No Abstract.]

12th February, 1935.

The President in the Chair.

MR. FREDERICK ADDEY, B.Sc.

“ SAFETY SIGNALS AND SIGNPOSTS OF THE SEA.”

Slides.

[No Abstract.]

26th February, 1935.

The President in the Chair.

MR. R. NOEL FINLAY.

“ IDEAL TELEVISION VIEWING.”

Slides.

(This paper was awarded a prize by the Society.)

12th March, 1935.

Dr. Richard H. Hunter, M.R.I.A., President, in the Chair.

JOHN FREDERICK ASHBY.

“ ROMANCE AND HUMOUR OF BANKING.”

Banking is not usually associated with either romance or humour. No doubt to those engaged in it it is a prosaic enough business. Yet, looking back on the long process by which the banks have developed, the story may become as interesting as a novel.

As you will gather from my title, I hope to deal with some of the more interesting sidelights on the history of banking. Let me anticipate any criticism by saying that I do not intend to embark on any theories of money or banking, and I shall endeavour as far as possible to avoid any dry dates and statistics.

The banking system as we see it to-day is a remarkable result of an evolution that has gone on for hundreds of years. Like many other essentially British institutions, perhaps the majority, it has never been intelligently planned but has grown up more or less by chance. It was perhaps inevitable that it should have taken its present form in view of the many political and other influences that have gone to its shaping. It is admitted that the banking system has its critics. Yet it must be claimed that it has successfully stood the test of time, and the shocks which have brought down the banking structures in many parts of the world have left our own banks not only unshaken, but in a stronger position than ever.

Within the past few years we have seen the banking systems of other countries give way before the storm one by one. No so long ago, virtually every bank in the United States had to close its doors. During all this time, and in

face of economic difficulties of an unprecedented kind, not the least breath of suspicion has touched the British banking system. I might perhaps repeat the words of the Chairman of the National Provincial Bank to the following effect:—

“ I can say without fear of contradiction that British banking is the product of evolution of progress based on the experience gained in the course of some centuries by men whose lives have been devoted to it. It has not only retained unimpaired the confidence of our own people, but is in addition the envy of the whole world. During the recent years of crisis, when banks in other countries were shaken and in many cases overwhelmed, the position of British banks was never called in question, and even the upheaval in 1931 left the system unscathed.

“ Surely any interference of a system that has proved so worthy is a matter for most careful consideration, and I doubt whether it is appreciated how great a shock would be given to the prosperity of this country by any rash experiments with this well-tried system.”

I hope to say something later on about the criticisms, mostly political, which are aimed at the banking system. Meanwhile, my immediate task is to endeavour to trace the process by which the banks assumed their present form. It is a story of experiment, of trial and error which, however commonplace the matter with which it deals, is often most fascinating.

MONEY.

It will perhaps be interesting if I define briefly at the outset the lines on which my story will run. First we have to deal with money, what it was in the beginning and what it has become to-day. The second part of the story deals with the growth of the banks themselves from the early efforts of the Lombards, through the Goldsmiths and merchant adventurers to the private bankers and the steps which have led to the existing joint stock system.

The plot unfolds itself on two-fold lines. With regard to money, there is the gradual development from simple barter, through different kinds of currencies to banknotes and ultimately to the credit system as we know it to-day.

It may be useful to say a few words about money because, after all, money is the principal medium with which

the banks have to deal. Money is not so easy of definition as some people might think. It is, or should be, a medium of exchange. Perhaps that is the simplest and truest definition that may be found. But it has come to be a great deal more than that.

Without venturing too far into controversial matters, it might be asked how far the present troubles of the world are due to the fact that money has been divorced from its primary use as a medium of exchange, and become a commodity to be dealt in like other commodities, and very much as an end in itself.

It is usual, I know, in discussing a subject of this kind to go back to the beginnings of things. Whether such a course is altogether wise and legitimate I am somewhat inclined to doubt. The monetary system, like the banking system, is an exceedingly complicated matter. In its present form it is subject to influences, sometimes called laws, which do not apply to its simpler origins. The conditions of the great Public School or University are necessarily very different from those of the Kindergarten. Similarly, I sometimes wonder if it is entirely legitimate in discussing a complex system to illustrate it by taking out some of its simplest elements. Nevertheless, the method has certain conveniences and is invariably the one chosen.

In the simplest form of community we can imagine all trading done by barter, which is a direct exchange of goods for goods. At one stage further we can consider goods being exchanged for services. It is a significant comment on the world of to-day that its elaborate system of exchange developed over hundreds of years has so far broken down, that not only individuals but great nations have had to return to the primitive methods of barter.

The explanation of this is perhaps not altogether a simple one, but is largely due to a general failure of confidence between nations. It is not altogether easy to say how money began. Certainly some medium of exchange has been in use from very early times. Legend, more than the history, takes back the origins of money to the Ox. This traditional animal has to bear a heavy responsibility, whether justly or not I am not quite sure. Anyhow, Thomas Carlyle has put into a well-known passage a picture of the origin of money which is worth quoting, whether it is scientifically accurate or not:—

“ A simple invention it was,” he says, “ in the old world grazier—sick of lugging his slow ox about the country till he got it bartered for corn or oil—to take a piece of leather, and thereon scratch or stamp the mere figure of an ox (or *Pecus*) ; put it in his pocket, and call it *pecunia*, money. Yet hereby did barter grow sale, the leathern money is now golden and paper, and all miracles have been out-miracled; for there are Rothschilds, and English national debts: and whoso has sixpence is sovereign (to the length of sixpence) over all men; commands cooks to feed him, philosophers to teach him, kings to mount guard over him—to the length of sixpence.”

The old philosopher's picturesque description is probably in general terms not far from the truth. Men did no doubt in early ages barter corn or oil for cattle, and in fact cattle are generally recognised as one of the earliest forms of wealth. You have only to read the Old Testament to recognise this. Then came a time when goods themselves, whether produce of the earth or something manufactured like clothes or weapons, were represented by tokens. Sometimes the token represented the actual commodity being exchanged. In China as far back as a thousand years before Christ there were coins in use made in the likeness of spades and knives. Barter persists to some extent to the present day. There is a story of a famous French singer who in the course of a tour round the world gave a concert in the Society Islands. She was paid in kind, and her share of the proceeds consisted of three pigs, twenty-three turkeys, forty-four chickens, five thousand coconuts and large quantities of bananas, lemons and oranges.

Some part of this embarrassing fee had to be used to keep the other part alive, as the animals had to be fed on the fruit. It was calculated that in Paris her fee would have been equivalent to 4,000 francs. Those of you who have a taste for economics will recognise in this the need for the quality of portability which is one of the essentials of a sound currency. The others are that it should be acceptable, divisible, and indestructible.

There is scarcely a commodity or article of value that has not been used at some time or other as money. I have already mentioned cattle, but shells, furs, salt, opium, tobacco, rice, tea, iron bars, knives, spades and bullets have all been used as money at some time or another,

Some very interesting illustrations of the use of ornaments for currency are found in the Old Testament. I might say incidentally that the precious metals were utilised as money from an early date in view of their durability and also their scarcity value. Ornaments were used as money in very early times. In the book of Genesis the story of the dealings between Abraham's servant and Rebecca give an interesting example of the use of gold as an early currency. The story relates:—

“It came to pass as the camels had done drinking that the man took a golden earring of half a shekel weight and two bracelets for her hands of ten shekels weight of gold and gave them to Rebecca.”

In the same book we find Abraham:—

“Weighed to Ephron the silver which he had named in the audience of the sons of Heth, four hundred shekels of silver, current money with the Merchant.”

In connection with the use of the precious metals as currency, I shall have something to say later on about gold chains in speaking of the Goldsmiths.

From the use of commodities or specific articles as money to coins marks a tremendous advance. Some of the oldest known coins are believed to have been minted about 700 B.C. in Asia Minor. They were made of electrum, a natural alloy of gold and silver. The introduction of a double system of gold and silver, with weights calculated so that the two metals could be readily exchanged, is credited to Croesus, King of Lydia, in 561 B.C., whose name has been proverbial ever since for great wealth.

This venture into the origin of money may look like a digression, but it is really necessary as an introduction to banking itself. One point has always struck me which I should like to emphasise. It is that as money has got further and further from the original state of barter, it has become less like the thing it represents. For example, the early Chinese coins I have mentioned were made in the form of the spades and knives which they represented. The figure of the Ox we may imagine was stamped on a piece of leather. Then came coins, which were merely tokens of value. After that, as we shall see, came banknotes and other signed documents which were and are in themselves

nothing more than promises to pay. It is a significant thought that the greater part of modern commerce is carried on by nothing more than a promise to pay, whether in the form of a banknote, a cheque, or a bill of exchange.

Actual coin amounts to very little in modern monetary transactions. The whole story of money is one of progressive substitution in the exchange of goods and services. Each new stage in the process is more remote from the thing actually dealt in. The first step is barter, where the goods themselves are exchanged; then tokens or substitutes are introduced; then come coins of more or less intrinsic value. Last of all comes the note or cheque, which is a promise to pay. I hope I have not unduly laboured this point, but the evolution from cash to credit, which may be nothing more than an entry in a book, lies at the base of the whole banking system.

The contrast between cash and credit at which I have hinted brings to mind a good story of an unusual form of currency, which I cannot omit. On the Island of Yap, in the Carolines, the money in use consists of solid stone discs, ranging in size from about that of a dinner plate to a cartwheel. As a form of money it may be understood that this currency is durable, and from all accounts acceptable, even if not easily portable. The stones are called Fei, and it is the usual custom for the larger specimens to be left standing outside the owner's hut, as no one is likely to take them away. Moreover, they afford a useful indication of wealth. The particular stone used for the manufacture of Fei is found on a neighbouring island.

The story goes that on a certain occasion a particularly large and fine specimen of Fei had been manufactured, and a special canoe had to be built to carry it over to where it was wanted in Yap. On the way a sudden storm arose, the canoe carrying the huge stone slipped from its tow rope and sank in a great depth of water. The problem then arose as to how to deal with this situation. Salvage operations were impossible, and the carving of this particular specimen had been a long and arduous business. Ultimately it was decided that as everybody knew the Fei was there in the ocean depths, and no one could take it away, the owner should be given credit for it just as though it were visible leaning against the side of his hut.

I think no more delightful instance could be found of the real meaning of credit, as the incident, which is a true one, illustrates exactly what is being done by the central banks to-day in respect of gold.

LOMBARDS AND GOLDSMITHS.

So much by way of introduction in reference to money. The story of banking itself brings in many new elements. There were banks in very early days. Most of them appear to be in the nature of state institutions, although it is on record that banks existed in ancient Rome and Greece, who received money on current account or deposit and paid it out to a written order. The great Bank of Venice, founded in 1157, is usually regarded as the first bank established on anything like modern lines. It was largely in the nature of a keeper of the national debt, but it can be readily understood that Venice, which was the great trading nation of the world at the time, would find scope for an institution to carry on large scale financial transactions.

Banking in this country really begins with the Bank of England. Before that, for many years, attempts were being made to establish methods of dealing conveniently with the rapidly growing wealth of the country. Modern banking owes much to the Lombard settlers, who came to this country from Italy after the Jews, who were the first money-lenders, had been banished by Edward I in 1290. They have left their impress on banking terms and traditions for all time. Their emblem of the three golden purses or balls, adopted from St. Nicholas, their patron saint, still survives in the pawnbroker's sign. They have given to us many of the familiar words used in trade to-day. The very word "bank," the terms "debtor," "creditor," "bankrupt," from the breaking of the table, or "banca," of the insolvent debtor, and the familiar "£.s.d." were all brought here by the Lombards. Lombard Street itself is named after them, and there is a Nicholas Lane turning out of it.

The Lombards were mostly goldsmiths or silversmiths, and they gradually worked up a large and influential trade as moneylenders and pawnbrokers. At first they may be regarded as pawnbrokers pure and simple, if those terms are applicable. For some three hundred years the goldsmiths were the principal financiers of the land. Kings went to them for loans, and the part they played in the financial

structure of the country as it then was has made history. A list of Goldsmiths in the year 1566 shows that 70 lived in Chepe, now Cheapside, and 31 in "Lumberde Streete."

The time in which the Goldsmiths flourished is one of the most picturesque periods in financial history. We have to remember that the system of credit as we know it had not yet come into existence. Wealth consisted not of balances in a bank, but of land, flocks and herds and the even more tangible form of gold and silver plate and jewellery. Although ready money was scarce, the whole economy of the business of the time was very largely a cash system. Few people handled much money at all, but such as there was was continually mutilated, clipped and debased. There was no real standard of value, although attempts were made to establish one from time to time.

The effect of the varying values of the coinage has been vividly described by Macaulay. He says: "Nothing could be purchased without a dispute. Over every counter there was wrangling from morning to night. The workman and his employer had a quarrel as regularly as Saturday came round. On a fair day or a market day the clamours, the reproaches, the taunts, the curses were incessant; and it was well if no booth was overturned and no head broken. No merchant would contract to deliver goods without making some stipulation about the quality of the coin in which he was to be paid. Even men of business were often bewildered by the confusion in to which all pecuniary transactions were thrown. The simple and the careless were pillaged without mercy by the extortioners whose demands grew even more rapidly than the money shrank. The price of the necessaries of life, of shoes, of ale, of oatmeal, rose fast. The labourer found that the bit of metal which when he received it was called a shilling, would hardly when he wanted to purchase a pot of beer, or a loaf of rye bread, go as far as sixpence."

Investment in securities was almost entirely unknown. Instead people put their wealth into gold and silver plate, jewels, brooches and girdles, and in rich garments of silk, velvet and fur. Every substantial house had its treasure chest with several locks and bound with iron bands in which the family treasure was kept. Valuables and odd sums of money were hidden in all sorts of curious hiding places. Sometimes detailed instructions were left in a Will as to

where the treasure was to be found. It was hidden in boxes and barrels, in old shoes, under floor boards, in holes in the wall, wrapped up in paper, or folded in sheets of lead.

I have already mentioned gold chains. From their convenience they were one of the favourite means of hoarding wealth, and it is said that after the death of Sir Thomas Gresham, one of the best known of the Goldsmiths, the greater part of his property consisted of gold chains.

Next to actual coin of a stable value, it can be realised very easily that gold chains offered many advantages. They would do so even to-day. It can be understood that a man could wind his gold chain round his neck, and it would serve the purpose both of ornament and portable currency. A link could easily be detached as and when required, and exchanged into current coin for any business transaction. It comes very near to the ideal currency in the way of portability, durability, and it is divisible and acceptable. A gold chain in this way may be said to fulfil all the functions of a portable bank, a current account and a letter of credit as well as being what it obviously is, a gold reserve.

Considering the subservience of most economists to the idea of gold as a basis of all currencies, the gold chain is a most suitable symbol.

The whole period of the Goldsmiths is notable for many outstanding figures; one of the best known was Sir Thomas Gresham, who lived in the days of Queen Elizabeth. The story of the grasshopper, which he adopted as his sign, may be legendary, but it was the sign of his business house in Lombard Street and the sign of the grasshopper is seen to-day outside Martins Bank on the same site. Martins claim descent from Gresham's Goldsmiths business. It was he who built the first Royal Exchange, and the Exchange to-day, although the third building on the site, is still surmounted by Gresham's grasshopper sign.

Sir Thomas Gresham was recognised as one of the greatest financial authorities of his time, and was the accredited financial adviser to Queen Elizabeth. Among other benefits he conferred on London was the founding of Gresham College, where he established six professorships. A course of lectures on the six subjects laid down by the foundation is given to this day. There is a good story of Sir Thomas Gresham relating to an occasion on

which he entertained the Spanish Ambassador to dinner. The Ambassador was boasting of the riches of his master, the King of Spain, and of the wealth of the Spanish Court. Sir Thomas said that the Queen had subjects who would expend at one meal as much as the daily revenue of the King of Spain and his whole Court. A wager was laid on the result. When the time came for the test, Sir Thomas put before his guest an ordinary meal. "Well, sir, you have lost your wager," said the Ambassador. "Not at all," replied Sir Thomas, "and this you shall presently see." He then took a box from his pocket, and produced an Eastern pearl of unusual size and value. He ground the pearl to powder and drank it in a glass of wine to the health of the Queen. "My lord Ambassador," he said, "you know I have often refused £15,000 for that pearl. Have I lost or won?" The Ambassador had to yield the wager was lost and said he did not think there were four subjects in the world who would do as much for their Sovereign. You will no doubt recognise this story as having in it the elements of another story of a like kind, but I believe the heroine of the better known story is Queen Cleopatra.

The age of Elizabeth is a notable one in many ways. Not least it is remarkable for the growing wealth of the country. Discovery of lands beyond the seas and the successful voyages of the great seamen of the age were bringing much wealth to this country. It is not difficult to understand that the Goldsmith business flourished, and foreign visitors spoke with something like awe of the stores of wealth to be found in the City of London. One Italian author describes Lombard Street as the handsomest in the City. He speaks of the fifty-two Goldsmiths' shops so rich and full of silver vessels, great and small, that he says "in all the shops in Milan, Rome, Venice and Florence put together, I do not think there would be found so much of magnificence that are to be seen in London."

GOLDSMITH TO BANKER.

As the principal dealers in money, the business of the Goldsmiths rapidly developed. The line of development appears to have followed this source. The Goldsmith was at first a jeweller and pawnbroker. He lent money on jewels or plate left with him just as a pawnbroker does

at the present day. In course of time the Goldsmiths' receipt known as a "*running cash*" used to be passed from hand to hand as a form of currency. It was really in the nature of a deposit receipt, and the amount of it was altered from time to time as sums were withdrawn. The Goldsmith gradually developed his business into what might be described as a Goldsmith Banker, and his "*running cash*" note was the forerunner of the banknote. The Goldsmiths combined the roles of tradesmen as dealers in jewellery and plate, pawnbrokers by making loans on property, and bankers inasmuch as they issued notes which developed into a useful form of currency. A list of Goldsmiths keeping "*running cashes*" in London in 1677 contains forty-four names, some of which still survive in modern banking firms. The Goldsmiths were thus in the direct line of succession to the modern bankers.

In the reign of Charles II, the Goldsmiths had become an influential community and were taking a prominent place in the financial life of the country. One of the best known was *Alderman Edward Backwell*, one of the King's bankers. His shop was in Lombard Street "at the South end of a new alley called Exchange Alley." Backwell was a Goldsmith as well as a banker, and no less than twenty-six references to his business are found in Pepys' Diary, who was one of his customers. Backwell's old ledgers are now in the possession of Messrs. Child & Co. and show that among his customers were not only the King, Charles II, but the Duke of York, Prince Rupert, the Duke of Monmouth, the Lord Chancellor, the Earl of Clarendon, in addition to the accounts of the East India Co., the Goldsmiths and other City Companies. These early records show that the Goldsmiths allowed interest on deposit as early as 1665, which may be regarded as a beginning of deposit banking. Another eminent Goldsmith was *Sir Robert Vyner*, who was Lord Mayor of London in 1665. He has been called the Prince of Goldsmiths.

Charles was in the habit of dining with the Citizens of London on Lord Mayor's Day, and did so in the year *Sir Robert Vyner* was Lord Mayor. The good Lord Mayor, who was an intensely loyal man, became somewhat more familiar with his Sovereign than the etiquette of such an occasion usually warranted. The King saw how matters were going, and when the toasts began to get too frequent

and too effective, he gave a hint to the company to avoid ceremony and made to reach his coach which stood waiting in Guildhall Yard. The story goes that enthusiasm and frequent potations had so affected the Mayor that he pursued the King and catching him by the hand cried out with a vehement oath and accent "Sir, you shall stay and take t'other bottle." The King looked at him over his shoulder and with a smile and a graceful air repeated the line of the old song, "He that's drunk is as great as a King," and immediately returned and finished the bottle as invited. There are some critics of Charles II, but probably no one would deny that he was as good a man as any to carry off a situation of the kind.

THE STOP OF THE EXCHEQUER.

One of the decisive events leading up to modern banking, although indirectly, was the famous "*Stop of the Exchequer*" by Charles II in 1672. Historians have well described it as "a short-sighted as well as an arbitrary act." It appears that the merchants and Goldsmiths were in the habit of keeping their surplus balances in the Exchequer. There is something of a parallel with this practice to-day in the way the Joint Stock Banks all keep accounts at the Bank of England.

The King was, as usual, short of money. He wanted a million and a half and did not care about applying to Parliament for this sum. Instead he took the extreme step of seizing the balances in the Exchequer belonging to the Goldsmiths. The leading Goldsmiths, such as Backwell and Vyner, lost very large amounts in this way, and several of them were brought to ruin. The King called this a loan and offered 6% interest, but this was rather poor consolation for the ten thousand depositors whose money was represented in the one million three hundred thousand seized by the King.

THE PRIVATE BANKERS.

It is not difficult to see how with trade and commerce gradually extending, and the need for improved facilities for dealing with money continually increasing, many Goldsmiths found it convenient to relinquish the business in plate and jewellery and take up banking proper. The credit of making the first decisive step must probably be given to

Francis Child, the founder of the historic bank which bears his name. It is now a part of *Glyn Mills & Co.* The house of *Child & Co.*, together with that of *Charles Hoare & Co.*, are the earliest of the private bankers. The word bank was in use as long before as the reign of Charles I, but in a somewhat loose sense. The bankers of that period were probably what we should call money changers and bullion dealers. The establishment of the private banks belongs very much to the same period as that which saw the origin of the Stock Exchange and Lloyds. None of them as an institution was consciously planned, but all of them arose more or less accidentally as an answer to the needs of the time. Macaulay says that "in the reign of William, old men were still living who could remember the days when there was not a single banking house in the City of London." During the next 150 years private banks were formed in rapid succession, and a return made in 1876 shows that there were no less than 554 *private banks*. In addition to the Goldsmiths, banking was adopted by many successful traders as a side line to their main business. Sometimes the banking business was floated off as a separate concern, thus the well-known banking business of *Coutts* began as a auxiliary to a flourishing trade in corn, wine, lead and fish. The *Barings* were importers of woollen and dyed fabrics. *Twinings* were dealers in tea; the tea business is still carried on, but the banking activities have been taken over by Lloyds. Another type of bank began in connection with certain industries, such as the *British Linen Bank*, which is now affiliated with Barclays but still carries in its name the traces of its early commercial origin.

It is not my intention here to enlarge on the theory of banking. My aim is to bring out as far as possible the romantic and, where it occurs, the humorous side of banking. The outstanding incident of the seventeenth century was the foundation of the Bank of England in 1694.

BANK OF ENGLAND.

There can be little doubt that the Bank of England was indirectly created as a result of the Stop of the Exchequer I have already mentioned, and the very easy going financial ideas of Charles II and James II. It is often said that the time brings out the man and in the same

way the needs of a given time create the institution to meet them. The industrial revolution with its tremendous impulse of capital needs was still far distant. But there was already in the air the stirring of a new growth of commerce demanding a more stable money system to deal with it. The private banks were scarcely adequate to meet this demand. The need for a National bank had been felt for many years. Attempts had been made to induce Oliver Cromwell to set up a State bank. Curiously enough, it was left to a Scotsman to formulate the scheme on which the Bank of England was eventually formed.

Many volumes have been written about this remarkable institution, and it is a subject of never failing interest. It was formed ostensibly to provide funds to carry on the war against France in which the country under King William was engaged. Its object was to lend the Government out of its Capital the sum of £1,200,000 at 8%. Its security was on "Rates and Duties upon tonnage of ships and vessels and upon beer, ale and other liquors." It had no monopoly; it could trade in nothing but Bills of Exchange, bullion and forfeited pledges. Some of its early ventures read curiously in the light of present day banking practice. In its time it has lent money on such things as property, and even, it is said, on a quarry. Much of the credit for the scheme is given to *William Paterson* who combined the antagonistic qualities of a preacher and a buccaneer. It is said that in his early life he carried a pedlar's pack throughout England; he led a precarious life for a time in the West Indies, and he took a considerable part in the tragic Darien Scheme. It is possible that too much credit is given to Paterson, for the formation of the Bank was largely due to *Charles Montague, Earl of Halifax, and First Lord of the Treasury*.

Michael Godfrey, the deputy Governor, was also largely instrumental in the early success of the Bank.

At the outset the newly formed Bank met with much opposition. It lost its first deputy Governor in a remarkable fashion. King William was himself directing operations at the siege of Namure, and Michael Godfrey had gone to the front to arrange for the transport of funds. The King remonstrated with Mr. Godfrey for running an unnecessary risk as he was not a soldier and could be of no use there. "Sire," said Mr. Godfrey, "I run no more

risk than your Majesty." But before the King could finish his courteous reply, a cannon shot killed the adventurous deputy Governor on the spot.

No one who has seen the imposing new building now going up on the site of the Bank of England can fail to be impressed. Yet this site, probably the most valuable in the world, has no value put on it in the Bank's balance sheet. Its actual value is probably incalculable. The whole constitution of the *Bank of England* is full of contradiction. It is to all intents and purposes a private Bank, yet its policies are dictated by parliament. It is the central Bank of the country; it holds the gold reserve and the cash reserves of all the other banks; it acts as agent for the Government and administers the National Debt. It is essentially the *Bankers Bank*. It has never been officially established as such, but the position developed as London became the financial centre of the country and the other banks kept their accounts at the Bank of England just as the Goldsmiths held accounts in the Exchequer.

Throughout the whole of her career the *Old Lady of Threadneedle Street* has been subject to much criticism and even to physical attack. At the time of the *Gordon Riots in 1780* the whole of the City was in turmoil for a week. It is interesting that the attention of the rioters should have been turned to the Bank of England for the troubles were essentially due to religious difficulties, and it must be said that the Old Lady, whatever her faults, has never taken part in religious controversy. The mob showed a fine impartiality. Roman Catholic churches were their first objective, but private houses and then Chapels of all denominations which happened to be without a spire were plundered and burnt. It was reported that the mob was on its way to the Bank. The Governor was called in and preparations made for defence; the clerks were armed, provisions were brought in, the old pewter inkstands were melted down for bullets and a strong force of soldiers stationed outside. Clerks and volunteers lined the route. The mob attacked the Bank twice but were driven off with losses. Ever since that night the Bank has been protected by a military guard. Their march through the City is one of the minor sights of London and affords a reminder that the Bank of England is actually, if not officially, a State Bank.

Many people have expressed curiosity as to why the Bank of England is called the Old Lady of Threadneedle Street. It is generally believed that the title was first given in a speech by Sheridan, the dramatist, in the House of Commons on the attempt of Pitt to compel the Bank to lend money to the Government at the time of the French War. A famous cartoon by Gilray published in 1797 is entitled "*The Old Lady of Threadneedle Street in danger.*" It depicts an angular female sitting on a padlocked chest marked Bank of England being assaulted by a very lanky gentleman. The lady is flinging up her arms and crying "Murder, murder, rape, murder! Oh, you villain! What, have I kept my honour untainted so long to have it broke up by you at last? Oh murder, rape, ravishment, ruin, ruin, ruin!"

The Bank began in a very modest way. It was first set up in Mercers Hall with only nineteen clerks. It was soon removed to Grocers Hall with fifty-four clerks, with an average salary of only £80 a year. The first building in Threadneedle Street was a modest square-fronted house, the home of the Governor, Sir Francis Houblon, next door to which were the Church and Churchyard of St. Christopher le Stocks, and the bodies interred in the Churchyard have since been removed as the land was incorporated in the Bank's building. Reference is often made to the body of one *Jenkins*, a clerk of the Bank, who was nearly seven feet in height. He was buried in the Churchyard within the site of the Bank to save his body from the attentions of the "*Resurrection men*," who were particularly active about that period. The area now enclosed by the Bank has been gradually extended and now includes not only the Church and Churchyard but a large number of houses and taverns. Until the rebuilding was started the garden within the Bank precincts was a famous feature of London life, but it has now been sacrificed in the cause of progress.

There is no time to deal with the Bank's troubled history. It is enough to say that it has had to meet a financial or economic crisis almost every ten years and many have been the devices to meet each situation as it arose. Some of the features of its early days are being incorporated in the new building. The remarkable statue of *King William III* set up in 1735 can still be seen. At the unveiling of this monument it is recorded that "The under

servants fired three volleys with small arms." The statue is in *Roman dress* with a long description dedicating it to "*The best of Princes.*" It used to stand in the Great Hall and it was once described to a visitor from the country by a friend who was showing him round as a statue of *Julius Caesar*.

There is a good story not generally known concerning some *black blotting paper*. It appears that many years ago one of the Governors used to indulge in a clandestine correspondence with certain friends and ordered a large quantity of black blotting paper so that any imprint of his writing should not be detected. On his death this blotting paper was stored away and regarded as useless. It so happened that in course of time Queen Victoria died and some genius bethought him of this black blotting paper, which was brought out from its hiding place and fitted in the blotting pads in all the public offices. The incident was seized with avidity by the daily papers which referred to the wonderful loyalty shown by the Bank in commemorating, in this striking way, the feeling of the nation at the death of the Queen.

Incidentally I believe the Bank of England was the first to employ *women clerks*, showing that it has quite a sound streak of progressiveness despite its usual Conservative ideas. The story goes that one of the first actions of the new women clerks was to ask for a looking glass.

PRIVATE BANKERS.

Modern banking may be said to begin with the Bank of England. The next era in banking for nearly 150 years was the period of the private Bankers. They represented a class now almost, if not entirely, extinct.

CHARACTER.

Their relation with their customers was much more intimate and friendly than the relationship between the joint stock Bankers and their customers to-day, however cordial that may be. It must be remembered that the private Bankers operated as individuals. They worked often in more or less isolated communities, issuing their own notes and with their interests very largely restricted

to the district in which they worked. The owner of the private Bank in the country district was not only a Banker but a guide, philosopher and friend and often held very much like a paternal relationship with his customers. The private Banks were unfortunately particularly vulnerable. They had nothing of the unity which marks the banking system of to-day and local troubles such as a bad harvest, the failure of the big factory in a country town, or some similar calamity would often have the effect of bringing them down.

There are some harrowing stories of runs on local banks, and they were often compelled to exert the utmost endeavours to replenish their cash in times of difficulty. Opposition and rivalries often involved them in serious losses. There is a well-known story of an attempt by *Lord Darlington* to break the famous *Backhouse Bank* in that town. Lord Darlington had instructed his tenants to pay their rent in notes issued by the Bank with the intention of collecting a large sum and then without warning presenting the notes in one body and demanding an immediate payment in gold. Jonathon Backhouse heard of this scheme and posted off to London to obtain sufficient gold to meet the demand. On the way back one of the wheels came off the chaise and to avoid the delay in having the wheel replaced he packed the gold at the back and drove into Darlington on three wheels. The attempt to *balance the cash* was successful, for when the Agent of the noble Lord presented the notes for payment they were all promptly cashed without demur. It is said that the Quaker banker offered to buy and pay for Raby in the same metal if his master would sell it.

The fact that *Quakers* represented so large an element in the business of banking is an interesting one to the student of character. There would appear to be something both in temperament and character making them unusually suitable for this profession. The Quaker was noted for his industry and probity and strict attention to business. If he was somewhat deficient in a sense of humour that was not regarded as a bad quality in a profession which held so much responsibility.

R. H. Mottram, whose novels of Banking life are among the best of the kind, has put forward the theory that

the success of the Quaker as a Banker was his ability to say "No." Be that as it may, a strong Quaker element persists in banking even at the present day. Barclays and Lloyds both have in them a strong Quaker element. To those who would like to read further into the romantic side of Private Banking I would recommend Mottram's three novels, "Our Mr. Dormer," "The Borough Monger" and "Castle Island," which carry the story of a private Bank through several generations. There is also a picturesque account of a private Bank in the West of England, entitled "Ovington's Bank," by Stanley Weyman.

The close connection between the personal character of the old Banker and his reputation is illustrated by the story of a well-known Lombard Street house which has since been incorporated in one of the Big Five. It concerns one of the original *Fullers of Fuller, Banbury & Co.*, now part of the *Westminster Bank*. The old Banker, it is said, lived over his shop, as was customary in those days. Immediately inside the narrow frontage was a steep winding staircase rising just inside the door. The washer-woman called once a week for the laundry and it was his custom to have a pint of beer deposited on the stairs for her refreshment. It happened one day, whether by accident or design we are not told, that a pot, presumably a quart, was put there instead of the usual pint. A customer thereupon immediately withdrew his account on the grounds that as the Banker was guilty of such alarming extravagance he was no longer a suitable custodian for his money.

THE BANKERS' CLEARING HOUSE.

An important step in Banking development which has had a tremendous influence on subsequent history was the foundation of the London Bankers' Clearing House. This remarkable institution, like many others, had a more or less accidental origin. It was started about 1775 although the practice of clearing had been in operation for many years before and was in use among the goldsmiths. About the middle of the seventeenth century it was the custom of the goldsmiths to keep running accounts with each other just as the Joint Stock Banks keep accounts with each other and with the Bank of England to this day.

Every day it was the duty of the "Walks clerks" in each Bank to take the bundle of cheques and bills payable

to each of the other Banks and settle the balance for or against them for the day. This meant obviously that the clerk in each bank would have to make perhaps a dozen or more calls in the execution of this task. To save all this labour some unknown genius devised the scheme of arranging a central meeting place and settling the differences in one operation instead of making a large number of laborious and unnecessary journeys.

It may be understood that if, for instance, Martins had claims for £500 on Child & Co. and Childs had claims for £400 on Martins it was much simpler for the two clerks to arrange the matter between them by one payment of £100 in cash or notes by Childs instead of each making a separate journey to the other house. The clerks used to meet at street corners or settle their differences on top of a post, then they established themselves at a tavern and later a large window of one of the Lombard Street Banks was used for this purpose until the *noise made by his uninvited guests compelled the Banker to turn them out.*

Ultimately a room was taken at Martins Bank for the business of the clearing, and later a special building was devoted to the purpose. As the number of Banks grew the business of the clearing naturally became more and more complicated. There were at one time as many as forty-six Banks in the clearing house, but through amalgamation the number has now been reduced to ten in addition to the Bank of England. Clearing houses have now been set up in the chief provincial towns as well as in London, but the London Clearing House still represents the greater part of this business. Last year the total of cheques and bills passed through the London Bankers' Clearing House was nearly *35 Thousand millions* (35,000,000,000), but the record year was 1929 when the total was nearly *45 Thousand millions* (45,000,000,000).

The ingenuity and the convenience of the method by which immense sums are passed through the clearing house every day without a single coin changing hands are a constant source of wonder. The method has been brought almost to a pitch of perfection by long use and I cannot help thinking that the difficulties of International Trade which at present is hindered and restricted at every turn by artificial obstacles, will eventually be solved by something on clearing house lines.

One significant feature of the method of the clearing house is that all the other Banks in the clearing have an account at the Bank of England. When the balances between the different banks are struck the sum due in any case is settled not by payment in coin or notes, as used to be the practice in the early days of the clearing, but by a debit or credit entry in the books of the Bank of England.

The method to my mind represents the very refinement of credit. We have travelled a long way from the time when men settled their transactions by gold or coins or even Bank notes. The development of the cheque system in this country has accomplished something very like a revolution, and the *cheque*, where credit is good, has advantages not to be found in any other method of payment.

The almost superstitious value with which the *cheque* is regarded is illustrated by an incident for which I can vouch personally. In the early days of the War a lady who had a fairly large sum in the shares of a Building Society became nervous as to what would happen to her money in case of invasion. Like many others she had the idea that the Germans would invade this country and seize all the money in the Banks and in similar institutions. She thought she would much rather have it in her own keeping. She thereupon withdrew all her money, which was paid to her in the form of a cheque. During the whole period of the War she carried this cheque about with her quite happy in the belief that her whole wealth was secure in her own hands. When the War came to an end the good lady repaid the same cheque to the Building Society from which she had taken it. It would be difficult to find a better example of the way in which credit has taken the place of cash.

I have tried to show, however inadequately, something of the process by which modern Banking was evolved out of the work of the goldsmiths which in itself was an advance on primitive barter. The subject is such a vast one that my difficulty has been more to know what to leave out than what to put in, and I must necessarily plead guilty to many omissions. There is another whole story that might be told of the development of the *Joint Stock Banks out of the Private Banking system, of the fight against the monopoly of the Bank of England* which led first to the formation of *Westminster Bank* and then in turn to the others of the *Big Five*, in that great movement which started just

over 100 years ago. There are many *critics* of the Banks, but apart from any political considerations it is only fair to say that the Banks themselves are *not political institutions*; they are custodians of other people's money and whatever may be said of their Policy, the business system being what it is, safety has to be their first consideration. It may be sufficient to say that the Big Five which represent between them the major part of English Banking have between them something like Three Hundred Thousand (300,000) shareholders and all the Banks in this country have something like 14 million (14,000,000) depositors. The Banks may not be generally regarded as democratic institutions, but these figures would appear to show that the public interest in them is fairly widespread.

ANNUAL MEETING.

The Annual Meeting of Shareholders and Members was held in the Old Museum Buildings on Thursday, 31st October, 1935, at 3.30 p.m., and among those present were Dr. R. H. Hunter (President, in the chair), Colonel Berry, Messrs. W. B. Burrowes (Hon. Treasurer), E. J. Elliott, Godfrey W. Ferguson, A. G. Pomeroy, M.A., Captain Turner, Professor W. B. Morton, M.A., Professor Gregg Wilson, D.Sc., and A. Deane (Hon. Secretary).

Apologies for inability to attend were received from Mr. F. Adens Heron, D.L., Mr. W. M. Crawford, B.A., and Mr. R. A. Mitchell, LL.B.

The Hon. Secretary intimated that the meeting had been advertised in the local papers and read the notice convening the meeting.

The Chairman called upon the Hon. Secretary to read the Council's Report for year ending 31st October, 1935.

REPORT 1934-35.

Your Council is again called upon to place before the Shareholders and Members present at this, the 114th Annual Meeting, the work of the Society during the year ended to-day, in accordance with the scheme framed under the Educational Endowments (Ireland) Act, 1885.

The Society has had an active, prosperous year in many respects, though the number of shareholders and members on the list has slightly fallen, being 210 as against 228 in the previous year. The reduction is mainly due to death or to the resignation of members living too far away to avail themselves of the lectures. Every effort should be made by members to increase the membership of the Society under the new subscription scheme whereby members are admitted on payment of 10/- annually.

Among the deaths your Council records with regret the passing of two shareholders—Mr. William Mayes, F.C.A., and Major Charles Blakiston Houston, D.L.

William Mayes died on the 3rd June last. In his early connection with the Society, he took a great interest in the Irish Antiquities Collection in the Society's Museum. He

was an authority on numismatics and got together an important collection of medals and belt plates of the Irish Volunteers of the 18th and early 19th centuries which to-day would be difficult to assemble. He was a Governor of the Linenhall Library and its Hon. Treasurer from 1912 until this year.

Major Charles Blakiston Houston died as recently as the 9th of this month. He had an active, genial personality and kindly disposition and his interests were wide and varied. He was a keen member of the Archaeological Section, interesting himself in the Ancient Monuments of Northern Ireland. He gave invaluable help in connexion with the excavation of the Nendrum Monastery at Mahee Island and wrote a short Guide to the Ruins. Your Council passed a resolution of sympathy at its last meeting which has been forwarded to Mrs. Houston.

Both shareholders will be missed among a large group of friends.

One share, No. 414, dated 18th December, 1900, held by the late William Mayes, has been transferred to his son, Captain T. H. Mayes.

Your Council records with regret the resignation of Mr. H. C. Lawlor, M.A., M.R.I.A., who was largely responsible for the formation in 1917 of the Archaeological Section, which was the outcome of some excavations he carried out at the Giant's Ring, and of which he was its energetic Secretary for many years. During that period several important excavations and restorations were carried out in Northern Ireland. The Section has been fortunate in securing in Mr. E. Estyn Evans, M.A., F.S.A., a very able and experienced Archaeologist as its Hon. Secretary.

To fill the resultant vacancies your Council co-opted Colonel R. G. Berry, M.R.I.A., to the Council and Mr. Evans has been appointed to represent your Society on the Ancient Monuments Advisory Committee, N.I.

BRITISH MEDICAL ASSOCIATION.

Professor Flynn and the Hon. Secretary were appointed to act on a local Committee appointed by the Northern Ireland Branch of the British Medical Association to make arrangements for the Belfast Meeting of this Association in 1937.

BRITISH ASSOCIATION MEETING.

Your Society was represented on a deputation which waited upon the Lord Mayor of Belfast to suggest that an invitation be sent to the British Association to hold one of its meetings in Belfast.

QUATERNARY RESEARCH.

Your Council decided to give a further grant this year of £15 towards the research last summer into the flora and fauna of the quaternary deposits in Ireland, under the direction of Professor Knud Jessen, of Copenhagen, and the Committee in charge is well satisfied with the important work carried out in Northern Ireland. The total amount of grant from the Society's funds for the two years amounted to £25.

PRIZE COMPETITION.

Your Council offered three prizes of £10 each for a thesis involving research on any one of the following subjects:—Archaeology, Architecture, Botany, Chemistry, Geology, History, Philosophy, Physics and Zoology. Eleven papers sent in anonymously were received in competition. Your Council were much indebted to those adjudicators who undertook to mark the papers and advise the Council. Only one award of £10 was made for a paper entitled "Ideal Television Viewing," by Mr. R. Noel Finlay. This paper, illustrated by slides, was read before the Society on the 26th February last and will be printed in the Society's Proceedings.

LECTURES.

In addition to the prize paper by Mr. R. Noel Finlay already referred to, seven lectures of an interesting and varied nature were given during the winter months. The President (Dr. Hunter) took as his presidential address "Mechanism and Vitalism"; Captain H. Plunket Woodgate dealt with "Modern Germany through British Eyes"; the Earl of Antrim spoke on "A Journey in Persia"; Dr. Thomas Bodkin lectured on two Irish Artists—James Barry and George Barret, two members of Sir Joshua Reynolds's Academy. Mr. Frederick Addy lectured on "Safety Signals and Signposts of the Sea"; Mr. F. J. Ashby on "The

Romance and Humour of Banking ”; while “ The Beginnings of Civilization ” formed the subject of a lecture by Professor Gordon Childe whose research work in prehistory has earned for him an international reputation. All the lectures except one were illustrated by slides and, on the whole, were well attended.

On the 17th May, arrangements were made for a visit to the Zoo at Bellevue, under the leadership of the President (Dr. Hunter), who gave a detailed explanation of the peculiarities of the animals, which was much enjoyed by all those present; while on the 12th June a visit was paid to the Corporation Harbour Power Station, when the members were shown over the buildings by Mr. F. H. Whysall, M.I.E.E., City Electrical Engineer and General Manager, who furnished an instructive detailed explanation of the working of the elaborate machinery installed there.

Thanks are due to the Lecturers and to Conductors of places visited for their stimulating addresses. Your Council is glad to report that arrangements have been made for a series of lectures to be given by distinguished lecturers during the coming winter. A printed programme will be forwarded to Shareholders and Members in the course of a few days.

ARCHAEOLOGICAL SECTION.

The Archaeological Section continues its good work. It is fortunate in having during the year as Chairman, Mr. Oliver Davies, M.A., and as Hon. Secretary, Mr. E. E. Evans, M.A., F.S.A., two trained archaeologists at Queen's University. The present session has been a particularly active one for the Section.

It has carried out one major excavation by itself and another in association with other funds; and has given grants for two minor excavations, one of which is not yet finished. The work on megalithic remains, which was so fruitfully inaugurated some years ago, has progressed favourably, and several monuments in the interior of Ulster and on the coast have been investigated. A survey of all remains in the Armagh district has been also started. It would appear that the interest taken by the public in archaeology is increasing, and members of the section show greater enthusiasm in its field activities. In addition, five

papers of practical importance were read before the section during the winter, and were well attended. A detailed report by the Committee will be submitted to the members of the section at its annual meeting early next month.

THE BUILDING.

Your Agents, Messrs Davison & Dickey, report that as and from the 1st December last, the only remaining room in the building was re-let to suitable and most desirable tenants. During the year certain improvements were made which have added considerably to the amenities of the building. The naked lamps in the Hall and Lecture Room were replaced by more powerful lamps enclosed in bowls, which, besides giving better light, prevent any glare on the eyes. Linoleum was put on the hall and staircase, serving the double purpose of deadening the sound and giving a more furnished appearance to the premises. The Ladies' Cloakroom was also improved by the provision of linoleum, mirror and general decoration. In addition names plates in bronze and white enamel mounted in bronze frame were provided. These have given great satisfaction to the tenants and do not detract from the appearance of the building. Your Council wish to record its thanks to Mr. Alec Davison for the personal interest he takes in the building.

HON. TREASURER.

The Hon. Treasurer, Mr. W. Bel Burrowes, will submit to you the receipts and payments and, if adopted, will be printed in the Society's Proceedings after the accounts have been audited by the Local Government Board Auditor in accordance with the regulations.

HON. LIBRARIAN.

Your Hon. Librarian (Mr. W. M. Crawford) reports that the work of receiving and registering the Exchange Proceedings and dividing them between the Municipal Museum Library and the Library of the Queen's University, Belfast, has continued as hitherto. One new exchange has been effected with the Powysland Club, Welshpool, for their publication "Collections: Historical and Archaeological relating to Montgomeryshire and its Borders." A useful publication for the Archaeologists.

Much progress has been made in the arrangement on the Museum Library shelves of the valuable and interesting sets of Transactions and Proceedings of British Societies, so that it is easier of access for consultation. Altogether the Museum Library is gradually increasing in its usefulness.

Unfortunately, Mr. Crawford is unable to attend the meeting through illness.

COUNCIL.

The meeting will be called upon to elect five members to the Council. The following five members of Council retire by rotation:—Colonel Berry, W. B. Burrowes (Hon. Treasurer), Very Rev. W. P. Carmody, E. J. Elliott, Prof. Gregg Wilson.

Dean Carmody does not seek re-election owing to the demands upon his time and the distance he has to travel to attend meetings. He thanks the Society for the honour conferred on him for so long. Your Council record with regret the resignation of their colleague. The remaining four members, namely, Messrs. Berry, Burrowes, Elliott and Gregg Wilson, offer themselves for re-election.

FINANCIAL STATEMENT.

The Hon. Treasurer (Mr. W. B. Burrowes) reported that the Society commenced the financial year with a debit balance of £54 8s 11d, and ended with an overdraft of £145 18s 8d, being an increase of £91 9s 9d.

This adverse balance is accounted for by a decrease in the rental of £48 5s 9d, while subscriptions were down by £3 18s 0d owing to arrears. There was an increase in the printing and stationery account of £34 13s 5d, also in the lecture expenses of £13 16s 9d.

It is hoped that with new members coming in, this debit balance will be considerably reduced during the present year. The rents have increased so far by £37 18s 1d.

ADOPTION OF REPORTS.

The Chairman, in moving the adoption of the reports, said that the Society had been working for some years with an overdraft at the bank which was due to the large

alterations to the buildings after the removal of the Society's Museum collections to the new Museum building at Stranmillis, but under the guidance of Mr. Burrowes the Council had pursued a prudent policy which placed them in a fairly sound position. The Council had a scheme for improving the seating accommodation which he hoped would result with a better attendance at the meetings. He had pleasure in proposing the adoption of the reports, which was seconded by Colonel Berry and carried unanimously.

ELECTION TO COUNCIL.

The election of Council resulted in the retention of Colonel Berry, Mr. W. B. Burrowes, Mr. E. J. Elliott and Professor Gregg Wilson, while the Right Hon. Samuel Cunningham took the seat vacated by the Very Rev. W. P. Carmody, Dean of Down.

THANKS TO PRESIDENT.

A vote of thanks to Dr. Hunter for his services during the year was moved by Mr. E. J. Elliott, who said that Dr. Hunter was a man of considerable distinction in scholastic circles and his Presidential Address certainly upheld his reputation. He had, in addition, shown himself a man of affairs and had attended their meetings with great regularity. The proposal was seconded by Captain Turner, M.C., and carried with applause.

Dr. Hunter, in replying, said he felt it a very great honour to follow so many distinguished men as President of such a fine old Society and it would always give him pleasure to be of service to it.

Subsequently a meeting of the new Council was held, when Dr. Hunter was unanimously elected President of the Society for the coming year.

ARCHAEOLOGICAL SECTION.

ANNUAL MEETING, 1934-35.

The Annual Meeting of the Archaeological Section was held in the Old Museum Buildings at 4 p.m. on Monday, 4th November, 1935. There was a good attendance of members and the Chairman, Mr. Oliver Davies, M.A., presided.

The Hon. Secretary, Mr. E. E. Evans, read the Committee's Report as follows:—

ANNUAL REPORT.

Your Committee is pleased to be able to issue an encouraging and favourable report for the past year. The activity of the Section has been greater than for some years previously, and the Committee has felt that the time has now come to spend on field-work some of the money which has accumulated recently; they have been in particular led to this view by the grant of 60% of wages for unskilled labour which has been provided this year by the Government, so that every pound given produces more than £2 of work. At the same time, several students of Queen's University have been taken on excavations and given some rudimentary training in the hope that at least some of them may later on have the time and interest to take up archaeological work themselves. We must admit that Ulster is still short of trained excavators, and the Committee regrets that, while great interest was shown by members of the section in coming to visit excavations in progress, the success of the appeal for volunteers to work was disappointing. The amount of training needed before directing small excavations or reporting emergency discoveries is not excessive, and those who should feel some hesitation at beginning a dig on their own, will find it easy to obtain some assistance in the first stages from someone more experienced. Your Committee would be glad to welcome applications regarding excavations which any member considers that it is desirable or urgent to carry out.

The excavations which have been carried out directly by the Section have mainly been in Co. Tyrone, the largest and until recently the least explored county in N. Ireland, though survey work in the last few years has shown the wealth of monuments which it possesses. Towards the end of March the Chairman of the Section (Mr. Oliver Davies) completely excavated the horned cairn at Clady Halliday, near Newtownstewart, assisted by Miss Gaffikin, Mrs. Anderson, Mr. B. Megaw, and other members of the Section. The monument is one of the best preserved of its class, and the light soil made it easy to discover the pits of stones which had been removed, so that save for one side which the owner would not permit digging, the shape of the monument was completely determined. It had three chambers and a forecourt, and was surrounded by a peristalith which formed the boundary of the original cairn. It is particularly remarkable in still possessing many of the stones which once roofed the chambers, so that it provides important evidence as to how such structures were covered. The finds included two cremations, many pieces of rather coarse and primitive pottery, and several good flints, above all a leaf-shaped arrow-head and a polished javelin.

In late September and early October Mr. Davies excavated the cairn of Dun Ruadh, near Greencastle, with funds provided both by the Section and the Belfast Municipal Museum, aided by the Government grant for labour. He was assisted by Miss Gaffikin, Mrs. Anderson, and several students, and was visited by members of the Section. The cairn is roughly pear-shaped with a ring of stones round the centre; it is of an unusual type and one of the largest in Ulster. Into it there were inserted at a later date several burial cists, in one of which was found a complete urn. Other finds include fragments of other urns, much Neolithic pottery, and several good flints; but the main object of the excavation, seeing that the cairn is known to have been badly rifled in the last 40 years, was to obtain an accurate plan, and to compare it with those monuments in Brittany and elsewhere. The work could not be completed in the time available, though it has progressed much further than was anticipated, and it is hoped to finish it next summer.

Your Committee is glad to report the excavation by the Hon. Secretary of the Section (Mr. E. E. Evans) of a

horned cairn at Dunloy, Co. Antrim, which yielded a good plan, a series of cremation pits, and a remarkable collection of early pottery and flints. This excavation was carried out under the Belfast Municipal Museum grant, but the Section is fortunate in having a report of the work to be read in January next.

A small excavation was carried out by Miss Gaffikin and Mr. Oliver Davies at a fort at Sallagh Braes, near Larne, under the auspices of the Section. More than one period of occupation was established, and in particular it was proved that the souterrain was originally partly above ground, a fact which may be of value in tracing the evolution of this type of dwelling. This excavation will probably be completed this winter.

Mr. H. C. Lawlor carried out, under the auspices of the Section, a small excavation at Downpatrick motte, where he discovered a great deal of interesting Norman pottery.

The Committee is glad to report the complete excavation of the promontory fort of Larrybane, on the N. Antrim coast, under the Belfast Municipal Museum grant, by Prof. Gordon Childe. The fort yielded a great deal of material dating to the Dark Ages. Your Committee feels that N. Ireland is much honoured by the presence of an expert like Prof. Childe, and is glad to know that he will return for further excavation.

A survey of the sites on the Dundrum sandhills is being undertaken by Mr. Davies and Miss Gaffikin. It is felt that these sites have for too long proved quarries for collectors, who, animated by no scientific spirit, have failed to observe the find-spots of the objects they obtained, or have encouraged indiscriminate plunder by buying antiquities from local dealers. It is hoped that members of the Section will assist this survey, both by not digging in the settlement layers, and by informing those who carrying it out of objects they may have found or may find, so that these may be noted and drawn for publication.

A survey of the antiquities of the Emania district is being carried out by Col. Berry, assisted by a sub-committee of the Section. A great number of interesting relics have been found and plotted on the map, but the Survey is not

yet completed, and many conclusions will probably emerge later. The Section is fortunate in having Col. Berry to read a paper this autumn on his provisional results.

Two members of the Committee (Miss Gaffikin and Mr. Evans) have co-operated in publishing maps and a paper on the Megaliths and Raths of the Province. This work was done under the auspices of the Belfast Naturalists' Field Club.

Members of the Committee have also investigated prehistoric burials reported from Fivemiletown and Greencastle (Co. Tyrone), Ballynagassey and Feeny (Co. Derry) and have secured urns for the Museum from the first two sites.

Six papers were read during last session: Col. Berry on "Emania"; Rev. Leo M'Keown on "Early Monastic Orders in Ulster"; Prof. Llubera on "Spanish Cathedrals"; Messrs. Davies and Evans on "Excavation of a Horned Cairn on Browndod Hill"; Miss Gaffikin on "A comparative analysis of different types of prehistoric pottery"; Mr. A. W. Lindsay on "Excavations of a souterrain at Dunalis." For this session there have been arranged so far five papers, by Col. Berry on "Emania"; by Mr. Evans on "Excavations at Dunloy"; by Mr. Davies on "Excavations at Clady Halliday"; by Prof. Sinclair on "Greek Education"; by Mr. Povey on "The Early Printing Press and how it worked."

In moving the adoption of the Report, the Very Rev. the Dean of Down stated that he thought that the work of the Section during the past year had been very creditable, and that he was much pleased at this display of activity in a society in which he personally took particular interest, as he had been its chairman for many years. He was ashamed to confess that ten years ago there were prominent archaeologists in Ulster who considered that there was no more to be discovered about Irish archaeology, but the recent excavations showed that we were only on the threshold of numerous problems, and that many years of work lies ahead of Northern Ireland archaeologists. The Dean thought that it would be necessary to consider means for the proper publication of the excavations and finds, and recommended that the Committee should place this question on their Agenda at an early date. The motion was seconded by Mr. Davison and passed unanimously.

Mr. Evans then read the report of the Treasurer, which showed that though the balance of the Section had decreased £30 during the last year owing to the numerous excavations which had been carried out, there was still £110 10s 8d in hand.

There were elected as officers for the coming year:—Chairman, Mr. O. Davies, M.A., of Queen's University, and as Hon. Secretary Mr. E. E. Evans, M.A., F.S.A., of Queen's University. The other members of the Committee elected were:—Col. R. G. Berry, Mr. A. A. Campbell, the Very Rev. W. P. Carmody, Mr. E. J. Elliott, Miss M. Gaffikin, Mr. R. S. Lepper, Mr. J. Skillen; and with the ex-officio members, the President of the Society (Dr. R. H. Hunter), the Honorary Treasurer of the Society (Mr. W. B. Burrowes) and the Hon. Secretary of the Society (Mr. A. Deane), the newly-elected Committee consists of twelve.

THE DUNALIS SOUTERRAIN AND OGHAM STONE.

(With Figs. I—V and Plan.)

By A. W. LINDSAY, B.A., B.A.I.

In my capacity as Resident Engineer in charge of the Coleraine and Portstewart Reservoir, I had from time to time heard mention of a "cove" or tunnel by the workmen, most of whom were local men. In the vicinity of the Reservoir were the remains of the old fort of Dunalis. This fort could not be located, but mention is made of it in the original notes of the Co. Londonderry 1835 survey. I naturally concluded that if such a "cove" existed it would be in connection with this fort. I was unable to obtain any information on the probable site of this "cove" and believe I discovered a different one from that for which I was searching. Thus, when I opened the souterrain in the townland of Dunalis, it was purely due to the promptings of curiosity and a desire to locate that which had for so long eluded me. I had no idea it would be the centre of interest it has since become. The interest is natural, because this souterrain contains the first Ogham stone found north of Connor in the County of Antrim, the seventh in the Province of Ulster, and the first since 1896, when the Rev. W. P. Carmody, now Dean of Down, discovered two in a souterrain at Connor.

THE SOUTERRAIN.

The site of the souterrain is about $3\frac{1}{2}$ miles out of Coleraine on the "Murder Hole" Road and close to the west boundary of the Coleraine and Portstewart Reservoir.¹ It is situated in the townland of Dunalis, which apparently derives its name from the fort already mentioned.

The immediate surroundings have been inhabited from early times. I have found flint and basalt implements in the ground which has recently been covered by the water in the new reservoir.

¹ I would like to thank Mr. William Fulton, the owner, for his kind permission to examine the souterrain and Messrs. Glassey, Gribbon, Evans, Davies and Prof. Macalister for their help and advice.

The souterrain itself was surmounted by a ringed enclosure, which is now demolished and invisible to the eye, but the older people in the district well remember the accounts of the "circle" on which the dew and frost never lay at night.

Entrance was first effected by removing a roofing stone in Chamber No. 3 (see Plan). This gave access to Chambers Nos. 2 and 1. A transverse Chamber at the western end of Chamber No. 3 was located at a later date.

Chamber No. 2 was found to be in excellent condition and the floor remarkably dry, which state, however, did not last long. Chamber No. 3 was partly filled in with earth. Chamber No. 1 was in a much worse state and I discovered subsequently that it had been filled in about 60 years ago² when, as so frequently happens, a roofing stone was displaced by a plough.

I will now deal with the Chambers in the order in which they were surveyed and examined, i.e. Nos. 2, 3 and 1.

Chamber No. 2 (see figs. 1a, 1b, IIa and IIb) is certainly the most interesting of the three apart from the fact that it contains the Ogham Stone. It is 20 feet long and whole in every detail. The walls are constructed of weathered basaltic field boulders well bonded together and narrowing *very* slightly towards the top. It has a minimum height of six feet except in one place where a transverse stone allows only 4 feet 9 inches head room. A small Chamber, 6 feet long, and approximately at right angles to the main gallery, faces portal 2-3,³ the end wall of which is highly decomposed basalt of red colour. This type of rock is so soft that one is tempted to wonder why the builders did not continue excavation through it.

The roof is formed of five large stones laid transversely, the most easterly of which carries the Ogham inscription.

² Dr. Chart showed me a plan of a souterrain at Dunalis in the files of O.S. Co. Derry in the Record Office, Belfast, made about 1834/5. It is clearly the souterrain that I explored despite certain inaccuracies, and shows that Chambers 2 and 3 were filled before the land reclamation about 1875.

³ When referring to portals I denominate them as 1-2, 2-3, i.e. 2-1 means the portal between Chamber 2 and Chamber 1 considered from Chamber 2, 1-2 is the same portal considered from Chamber No. 1.

The intervening spaces are covered in the usual way with large flat slabs. The western end is completely covered by a slab weighing approximately three-quarters of a ton.

Near the portal 2-1 (fig. Ib) a pile of about 15 stones was noticed; this is not unusual near portals, and it is supposed they were left in readiness to stop the portal against invasion.

Access to Chamber No. 3 from Chamber No. 2 is effected by means of a massive and well bonded portal (fig. IIa). The sill of this portal is 3 feet 6 inches above the floor level and the portal itself measures 24 inches square. A convenient step below this portal is formed by a piece of quarried rock seen at the bottom of fig. Ia. (The arrow on the end wall points into the portal.) I believe that this piece of rock was originally kept in Chamber No. 3 for the purpose of obstructing the portal, and a recess, which would just hold this stone, exists in Chamber No. 3.

CHAMBER NO. 3.

Chamber No. 3 is in itself only worth the briefest description. It is 26 feet 6 inches long and substantially built. The walls, however, are inclined to converge more to the top than in the case of Chamber No. 2, and are also more irregular. There is also marked rotundity at both ends. The floor slopes upwards towards the west on account of underlying rock and at the western end headroom is reduced to 4 feet 8 inches where a portal leads to the transverse Chamber. Chamber No. 3, however, has this claim to distinction: it is the custodian of two fine examples of drilled basalt, reference to which will be made later.

While investigations were proceeding in No. 2 Chamber, Nos. 1 and 3 were being emptied of earth and boulders. This was made possible by the Route Field Club, Coleraine, who, fully realising the value of the discovery in their district, supplied funds to have the souterrain cleared out and a permanent entrance made.

Chamber No. 1 when cleared was investigated in detail. Access had, of course, always been possible, but only for a few feet. The portal 2-1 is only 17 inches wide and 3 feet long, so those who may contemplate a visit to see the Ogham stone should bear in mind the narrowness of the passage.

The floor of Chamber No. 1 is lower than Chamber No. 2, but a step was incorporated in the design (fig. IV) below the portal sill level. This gallery, which is 17 feet 6 inches long, is of a different quality of workmanship from the others. Mr. S. D. Glassey, F.R.S.A., noticed this immediately and considered it to be of more recent construction. It was not, however, until a photograph (fig. Ib) was examined that this supposition was confirmed beyond doubt. The lack of bond in the masonry above the right hand jamb is easily noticed and closer examination revealed the fact that spalls were used in the left hand corner but nowhere else in the structure.

The eastern end of this Chamber is a solid outcrop of rock. On the Plan three massive boulders are depicted in the south side. I imagine they must weigh about 5 tons each. They were probably embedded in the ground when the preliminary trench was dug and later rolled to one side to form part of the wall. The swell at the end of the Chamber indicates difficulty in moving them or in getting them to lie where wanted. There are wide gaps between them and it has been possible to insert a crowbar six feet in the spaces. At the east end an obvious portal exists, but it is closely packed with stones which appear to be held in place by subsidence of the lintel. In any case it has been impossible to move them. The entrance was through this portal, but I am unable to say what the approach was like. Probing the ground with crowbars has revealed the presence of large stones where the entrance should be, but as these are obviously displaced from their original position, it was decided not to excavate. Moreover, the east end of the floor is below the Reservoir top water level.

The new permanent entrance is over the east end of this Chamber and is through the opening left by the removal of the roofing slab 60 years ago. The structure of the souterrain has been left untouched.

The transverse Chamber runs nearly north and south, and is known to be *at least* 47 feet long, although all but 18 feet is filled in. It is only 3 feet 4 inches high on the average. The unfilled portion has a small Chamber 6 feet long at right angles to it, and through the roof of this Chamber entry was made.

The only item of note in this Chamber is a rather peculiar one, and will, I am certain, tax to the utmost, the credulity of my readers. I entered this Chamber alone one night with a powerful petrol lamp, which I placed against the wall; I immediately became interested in the high polish on some of the stones in the wall. Shortly afterwards I noticed a peculiar odour, which under the circumstances I could not immediately define. Later, I realised it was the characteristic odour one associates with a flock of sheep. A man who was assisting me entered the souterrain at this time and immediately commented on the "strange smell." A few minutes later his son joined us and said "Father, what a smell of goats!" Now, I had already associated the polished stones with the keeping of sheep or goats in this Chamber, but had not mentioned this to my assistants. A further point worthy of note is that the lad, who had been scratching the back of his hand against a stone, got an overpowering odour of the same kind from it and I confirmed this by rubbing my bare arm against the same stone. I also observed that the polished parts extend from the floor to 9 inches from the roof and that polish exists on parts of stones which one would not expect to be rubbed under normal conditions of occupancy by human beings. It would appear that the first indications we got were due to the heat from the lamp acting on one of the polished stones and melting a thin film of grease,⁴ thus releasing the odour. It should be remembered that this Chamber had only now been opened and its existence was unknown to the oldest men who had ever worked in this field.

Professor R. A. S. Macalister, F.S.A., M.R.I.A., has also noticed polished surfaces on stones in a souterrain which he thought might be due to the herding of flocks underground, but the opinion of a practical farmer was that they would suffocate. In the case of the Dunalis souterrain, however, there is always a good current of air circulating, sufficient to make a candle flame flicker almost to the point of extinction. I think it is also safe to state that this Chamber has been closed for at least 100 years. All chance of contamination from outside being the cause of the odour was obviated by a thorough examination of

⁴Scrapings from a polished stone, on analysis, showed no trace of fats,

boots and clothing, but the phenomenon can be vouched for by Mr. David Hamilton of Ballinteer, Coleraine, and by his son David, both of whom were my assistants that night.

ROCK CUTTING.

The methods employed by primitive people to cut, dress or remove rock have always excited interest, and in connection with souterrains, while several instances are known where rock was "worked," I have not come across any references to the actual methods or tools employed. I am, therefore, pleased to state that the Dunalis Souterrain has yielded evidence as to one method employed.

Chamber No. 3 contains three samples of apparently worked rock. The most important one, in my opinion, is the outcrop (fig. IIIa) which is shown on the general plan. It may be safely assumed that this outcrop was much larger and proved an obstacle to the inhabitants. Reference to fig. IIIa will reveal three holes in the flat top and numerous holes in the broken face. It can be easily seen that these have a definite formation. Some are shallow, whereas others are up to one inch deep. They all have this similarity, that they are no narrower at the top than at the bottom, which is in distinct contrast to the numerous steam cavities with which these basaltic boulders abound. Also, within limits, they are all uniform in diameter. As an engineer, I immediately realised that these holes were probably connected with rock breaking by a method not unknown to-day, when explosives are inadvisable. A row of holes is drilled and into these steel wedges are driven to split the rock. Perhaps wooden wedges were used by the souterrain builders, but the drills must have been of iron.

Fig. IIIb shows a boulder in the bottom course of the wall in Chamber No. 3. This has also very distinct drill holes, one of which is quite $1\frac{1}{2}$ inches deep. A noticeable characteristic of this stone is that while the axes of the holes are *not* parallel, they are all at approximately the same angle to the surface of the stone. Some of the holes appear to be steam cavities drilled deeper.

Chamber No. 3 also contains a few smaller stones in the walls with distinct drill holes, and an outcrop of rock in

the floor projecting from the north wall has obviously been worked to reduce it in size, but no tool marks are noticeable.

The stone step in Chamber No. 2 for portal 2-3 (fig. Ia) has also drill holes which may be seen.

Steam cavities differ from drill holes in shape, and the latter all contain a pasty deposit which can easily be removed with a knife blade, whereas the former are absolutely free from any mud or other deposits.

About one week after the discovery of the drilled holes, when No. 1 Chamber was being cleared out, I found a small stone on the floor of the gallery where it had lain under the debris. From its shape and position and the fact that one corner shows signs of considerable rubbing, I assume it formed part of the structure demolished. It showed a decided rust stain, and on closer examination after washing it proved to have a piece of oxide of iron adhering. Near it the end of another hole identical to the end of other drilled holes, can be detected. The specimen, although completely oxidised, has sharp features and appears to have a decided tool-mark in one portion.

The stone, although it has angular faces, is considerably weathered and presents two conflicting propositions:—

(1) If this is a remnant of a broken drill, and the stone a fragment of drilled rock, how has the iron survived the weathering that the stone has undergone?

(2) If the stone is not a fragment of quarried rock, what was the purpose of drilling it, considering its small size?

The stone was X-rayed by Dr. Martin of T.C.D. with negative results.*

The finds (see fig. V) were few, and are briefly summarised as follows:—

Pottery: Only six fragments of pottery were found, three in the souterrain and three in the ground disturbed by excavations above the transverse chamber. They are of coarse ware, typical of the Early Iron Age, 1.4—.9 cms.

*Mr. J. J. Hartley of the Geological Department of Queen's University, Belfast, was not convinced that this was not a natural concretion,—Ed.

thick, and mostly covered with soot on the outside. One piece, found in Chamber 1, is a portion of a neck just below the rim (fig. Va), and is only .5 cms. thick and is ornamented with relief-rib traversed by dashes of V-section 1 cm. apart. Another fragment has a perforated hole.

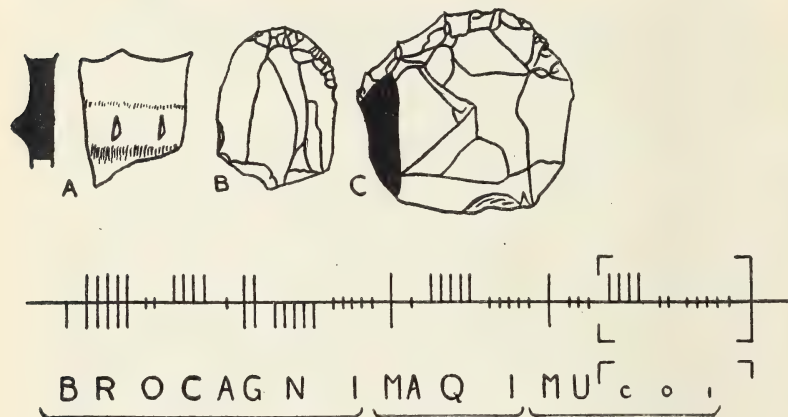


Fig. V.

Flints: Seven rough flint flakes were discovered in crevices between the wall-boulders in Chambers 2 and 3. With them was a rough scraper, nearly circular and about $5\frac{1}{2}$ cms. in diameter and with maximum thickness of 1.8 cms. (fig. Vc); the under-side is a flake surface, while on the upper side some of the cortex has not been chipped away (shown in black in illustration). Another finer scraper, 3 x 4 cms., has also a flake-surface on the under-side (fig. Vb). A piece of mica-schist somewhat resembling a small axe-head was found at the west end of Chamber 3. The edge may have been chipped to its present shape.

Bones: The bones were found in Chambers 1 and 3. Chamber 1 contained only two broken fragments of one ox bone in a crevice behind the wall; Chamber 3 twelve fragments of dog or wolf bones, six of which are vertebrae and six presumably leg-bones. The latter were all lying under the remains of two peat-fires, which yielded some

well-preserved and firm specimens of semi-carbonised peat, and are highly calcined. They were very kindly examined by Prof. T. Walmsley.

Ogham stones are common in South Ireland and exceptionally frequent in Co. Kerry,* but in the north they are very scarce. Hitherto only six have been discovered in the Province of Ulster:—

Two at Connor, Co. Antrim.

One at Drumconnell, Co. Armagh.

One at Aghascribagh, Co. Tyrone.

One at Castlederg, Co. Tyrone.

One at Topped Mountain, Co. Fermanagh.

They are also found in Wales, Cornwall, Scotland and the Isle of Man.

The situation of the Ogham stone in Chamber 2 at Dunalis is shown in fig. IIb. It is a weathered column of basalt 3 feet 10½ inches long and approximately one foot square in section. The inscription starts 14½ inches from one end of the stone and ends 12½ inches from the other end. It is 19½ inches long and fairly clear when seen on the plaster cast. It is, however, very difficult to read *in situ*. The lines are, in some instances, little better than scratches and in this respect resemble the two Connor Oghams, but are entirely different in character from the majority of Oghams found in other districts where, in comparison, the cyphers are formed by deep and broadly incised lines.

The inscription as copied from the plaster cast is reproduced in fig. V. I am indebted to Professor R. A. S. Macalister for the translation and following notes.

The name BROCAGNI is already familiar on these monuments. MAQI denotes "the son of" and the last two letters MU can hardly be anything other than the beginning of the word MUCOI and this would be succeeded by another name. The whole as it stands will read

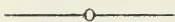
BROCAGNI MAQI MU(COI)

"The stone of Brocagnos (in later Irish, Brocan), son of the head of the family of" The word MUCOI implies descent from the ancestor to whom the family

*Cf. Cyril Fox, *The Personality of Britain* (1932), fig. 17.

traced their descent, and a person distinguished as " Mucoi so-and-so " would be something like the equivalent of some of the old Irish titles which are still in use, notably those prefixed by " The."

There are no traces whatever of any further lines to the right of MU and as the monument is quite free from all signs of fracture or defacement it can only be assumed that for some reason, which will remain a mystery, the inscription was never completed.



EXCAVATION OF A CHAMBERED HORNED CAIRN, BROWNDOD, CO. ANTRIM.

(With Figs. VI—IX and Plans.)

By E. E. EVANS and O. DAVIES.



INTRODUCTION.

Excavations were carried out in 1934 at a long cairn on Browndod Hill, some 4 miles N.N.W. of Parkgate, Co. Antrim. They were financed by a grant from the prehistoric research fund of the Belfast Corporation, which is administered by the Municipal Museum. The party consisted of Messrs. Davies and Evans of Queen's University, Mrs. N. Anderson, Miss Davison, Miss M. Gaffikin, Miss H. Sinclair, Mr. C. R. Raleigh Radford (Chief Inspector of Ancient Monuments for Wales), and a number of Honours students from the departments of Geography and Archaeology, Queen's University. Visitors to the site included Mr. H. C. Lawlor and Father Leo M'Keown, both of whom were previously acquainted with the monument; the latter has recently published a sketch-plan of it in *The Down and Connor Historical Society's Journal*, V, 1933. Our thanks are due to the owner of the land, Mr. Montgomery, for permission to excavate and for many courtesies during our visit, and also to the Ministry of Finance of Northern Ireland for allowing us to investigate a scheduled monument.

Work was begun on May 21st and continued for ten days. Although the monument had suffered extensive damage it proved possible to recover its main lines; and in the forecourt area we obtained many finds, as in previous megaliths of this class examined, and were able to reveal a very interesting if complicated structural sequence.

THE SITE AND THE CAIRN.¹

Browndod is a gorse-covered hill rising slightly above the general level of a somewhat detached part of the Antrim basalt plateau, of which it is geologically a part. It is easily recognised by a line of electricity pylons, one of which has been placed incongruously near the cairn—fortunately without damage to the actual monument. The hill reaches a height of 868 ft.; the megalith lies to the north of the summit at a point about 800 ft. above sea. It is rather inconspicuous among the rank heather, for most of the stones of the enveloping cairn have been removed; the roof has gone long ago and the standing stones have been badly smashed by heavy sledge-hammering; some of them are missing and some fallen. All the stones used in the construction are local basalt, shapely enough in their original massive rectangularity, but now often jagged and unprepossessing.

The long axis of the chambers (see Plan) runs approximately N.W.—S.E.; the horns, at the S.E. end, are set at an angle of some 20 degrees towards the east from this line. The axis of the cairn itself, so far as can be judged from its ruined condition, also differs from that of the chambers. This may be accidental, though several parallels could be cited, but the very marked tilting of the forecourt cannot be fortuitous. The same feature was observed at Goward.

The forecourt is more extensive than in the two horned cairns previously described before the Society; the façade of standing stones embraces nearly three parts of a circle, with a radius of 10 ft. For convenience of reference we have numbered the horn-stones on the plan, beginning with

¹ It is in Browndod townland. 6 in. Sheet 44 (Co. Antrim), 1 in. Sheet 28. Latitude 54° 46' N.; Longitude 6° 7' 30" W. A local name for the hill is "California." Mr. H. C. Lawlor suggests that this may be a corruption of some word embodying the element "carn," as for example in Cairne Grannia ("Carnegrany"), near Mallusk, Co. Antrim. [See P.R.I.A., vol. XXXII, pp. 239-42.]

No. 1 (north and south) for the portal stones. Stones 1, 2 (south) and 2 (north) are leaning, N1 and N7 are broken and N3 has apparently been wrenched into a position at right-angles to the façade. Nos. 4, 5 and 6 on both sides are in contact¹, a feature not previously found.

In height the uprights average 4 ft., of which some 2 ft. 6 ins. is at present buried in the cairn, both inside the forecourt and behind the horns. For nearly the whole of the forecourt was sealed by the cairn. We cannot say how high the stones had originally been piled in the forecourt. It is possible that they completely buried the portal, as at Annacloghmullin (if we may trust the reports), but the even surface which the forecourt presents suggests that the height was never much greater than it is now. In places, at least, it was certainly no higher in Early Iron Age times, as finds of that period show.

In the approximate centre of the forecourt is a partly collapsed and fractured monolith, five feet in length [the calculated centre of the forecourt is shown by a small white circle on the plan]. This stone may have been erected long subsequent to the building of the megalith, or it may be an original feature. A parallel may perhaps be found in the prostrate slab noticed by Mr. W. Lindsay Scott in the forecourt of Rudh an Dunain Chambered Cairn, Skye.²

THE CHAMBERS (cf. Fig. VII).

The four chambers have a total length of $43\frac{1}{2}$ ft. and are roughly equal in dimensions, although the end chamber is somewhat shortened by the massive 2 ft. square block, now broken a foot or so from the base, in which the series terminates. They average a little over 5 ft. in width. The first chamber, counting from the portal, has two slabs on each side; the remaining three each have six side-walls, though one is missing, another recumbent and a third has fallen in. Detailed description is rendered unnecessary,

¹ The plan is drawn on a higher plane and fails to bring this out.

² P.S.Ant. Scot., LXVI, pp. 183-213. There are also parallels in Sweden and Brittany. (Childe, *The Prehistory of Scotland*, p. 42). Cf. also the "pointer-stone" at Ballyalton (B.N.H.P.S., 1933-4.)

we trust, by the plan and sections. The lateral slabs are nothing like so regular as at Goward, but the sill-and-jamb construction is very similar in the two monuments.

There is no septal slab, however, between chambers 1 and 2. The two sills present are well shaped blocks some 2 ft. 4 ins. high. The jambs, where intact, rise well clear of the sills and are also substantially higher than the side-walls, a feature regarded by Professor Childe as a necessary corollary of the vaulted roof carried by the lateral slabs. The portal stones would also have risen, in all probability, above the side-walls of the first chamber (as they do at Ballyalton), notwithstanding the fact that these walls are higher in the first chamber than in the other three.

THE PERISTALITH.

Unlike the two cairns previously examined, Brownedod has definite remains of a peristalith. It is intact only at the N.E. corner, where three frontal uprights and eight smaller lateral flags join to form rather more than a right angle. The three east-facing (frontal) stones stand nearly 2 ft. above the present ground level and are almost flush with the cairn behind; they form an acute angle with the end of the north horn and their alignment is at right angles neither to the chambers nor, so far as can be judged, to the cairn.

The line of the peristalith can be traced by a bank which runs along the north-east side of the cairn, but nearly all its component uprights have gone. Three remain alongside the pylon; three more suggest a terminal angle 13 ft. further on, and another group the corresponding angle on the south-west (*see* plan). But there has been much disturbance here. Many loose stones litter the ground for another 20 ft. to the north-west, and among these stones were found three buried uprights which may be the remains of another (outer) peristalith. There is little evidence of any continuous peristalith along the south-west side, although two small uprights project above the ruined cairn in a position which correctly balances the opposite peristalith, assuming symmetry. The most likely course of the south-eastern wall, however, is marked by a steep bank, a foot or more high, which runs in approximate alignment with the supposed western corner as located at the rear.

This bank seems to mark the limit of fairly recent pillage, and even if it was once retained by a peristalith the latter would be so close to the chambers that the cairn must have buried it. No trace of the retaining wall could be found at the south-east end behind the south horn, though it may be presumed to have continued the alignment of the three standing stones which connect with the end of the opposite horn.

THE RED FLOOR (cf. Fig. VI).

Under the whole cairn (with the exception of one limited area in the forecourt) a distinctive layer of red soil was revealed wherever excavations were made. It consists of levigated interbasaltic material, probably obtained from the weathered outcrop of one of the basalt flows. A few hundred yards away such an outcrop occurs on the eastern face of the hill; and the attractively-coloured soil must have been carried to the site selected for the cairn. There seem to be few well-authenticated instances of a similar "foundation layer" under megalithic cairns in Ireland, although we noticed that some preparation of the kind had been made in the chambers at Ballyalton. In August of the same year, however, a floor of clean grey earth was discovered under a degenerate long cairn at Aghnaskeagh, Co. Louth, during excavations organised by the Office of Public Works of the Irish Free State.¹

Mr. W. J. Hemp has described a floor of purple clay which he found under part of the chambered cairn of Bryn Celli Ddu, Anglesea.² But whereas this floor was laid down as the final episode in the elaborate sequence of constructional events envisaged by the excavator, the spreading of the red layer at Brownodod was clearly one of the first tasks to be undertaken. It averaged 5 ins. in thickness, thinning out in places and reaching a maximum depth of 11 ins. in parts of the forecourt (section 6). Occasionally it rested

¹ *County Louth Archaeological Journal*, vol. IX, pp. 235-55. More recent excavations have revealed similar floors under a horned cairn at Clady Halliday and the circular cairn of Dun Ruadh, both in Co. Tyrone.

² *Archæologia*, 80 (1930), p. 204.

directly on an irregular rock surface, but it normally overlay a few inches of brown earth, analysed by soil-chemists¹ and described as typical Co. Antrim "till" or subsoil.

The top soil must have been removed over the area covered by the cairn before the red floor was deposited, so exposing the rock here and there but leaving some subsoil in most places. In Chamber 3 root holes could be traced through the subsoil, rising as far as the red layer but not penetrating it; these must be the remains of pre-cairn vegetation.² In the chambers the red floor usually had an inch or two of brownish earth above it (shown in the sections), but the distinction of colour has little significance, since the samples examined are stated to be identical. The surface of the red has been discoloured by peat water; the filling of Chamber 4, in particular, was very damp and peaty. It is conceivable, however, that the "upper brown" represents the floor of the chambers, laid down specially, as distinct from the floor of the cairn as a whole. The upper part of the red, and notably the top brown layer, contained a good deal of charcoal which, in the forecourt at least, must be ancient since it is sealed by the cairn.²

In one place alone was the red layer entirely absent— an oval patch a square yard in area on the south-west side of the monolith standing in the centre of the forecourt. This omission can hardly have been accidental. The brown subsoil here rose to the level of the top of the red round about it, which thinned out gradually (see section S7), and the whole was covered by original cairn except where dug away on one side for the erection of the standing stone. We presume the red-free area to have had some ritual significance; it may be observed that it lies on the main axis of the chambers (see plan).

The outer limit of the red floor could not be traced in the northern section of the cairn, but the erection of the pylon, as we have seen, had caused much disturbance here. Nor could it be determined precisely in the rear of the cairn, behind the two somewhat doubtful retaining walls examined.

¹ For this and another soil analyses we are indebted to J. C. Baird and R. H. Common, Department of Agriculture, Queen's University, Belfast. The help of Professor J. K. Charlesworth is also gratefully acknowledged.

² For identification of charcoals see below.

Frequently, indeed, the subsoil itself takes on a reddish colour, and it was difficult to say, except by clearing a fairly wide trench whether the red was present. There can be no doubt, however, about the general accuracy of the limit marked on the plan. It will be seen that on all sides the red floor extends beyond the area covered by the cairn. Its maximum measurements are 100 ft. in length and 55 ft. in breadth, opposite the ends of the façade.

CRESCENT OF STONES.

Extending for some 7 yards in the shape of the arc of a circle, a series of stones was exposed when clearing the area in front of the forecourt. The crescent lay with its convexity curving outwards, its centre to the north of the axis of the forecourt. There were never more than two layers of stones, and they were immediately below the turf, forming a scarcely perceptible ridge in the almost level surface of the hill top. While the horns of the crescent overlay the red floor, most of it lay outside; it appears, therefore, to have been laid down without reference to the red layer, and it may represent nothing more than the spoil of the forecourt-cairn, the edge of which here curves in suspiciously. But the stones were bedded in clean subsoil or else directly on the red, and not in humus, and a somewhat similar line of stones at Ballyalton, extending from the outer edge of the cairn on one side to the vicinity of the isolated "pointer-stone," must be recorded as a possible parallel. There can be no certainty in the absence of datable finds, but we are inclined to regard this curious crescent as an original feature. A small pocket of blue-black grains, containing broken-up peaty material and found at the outer edge of the crescent (section 6), may not be accidental.

CONTENTS OF THE CHAMBERS (cp. Fig. VI).

The normal stratification of the chambers showed from 1 to 2 ft. of black peaty soil, containing stones, resting on the red floor, which had a brown appearance, as we have seen, in the top inch or two. But the two outer chambers (1 and 2) must be distinguished from the two inner (3 and 4); in fact we may have to regard them as a passage leading to the chambers proper (3 and 4). The first (outermost) chamber had been dug into long ago, and also at a time not long before our investigation,

and as a result most of the red floor had disappeared. Where it remained intact, along the side walls, it was roughly paved with small flags on which the lateral slabs of the chamber often rested. The filling above, apart from a few inches of peaty skin, consisted of soft black earth well mixed with red. It is natural to assume that this mixed black and red material is the result of post-megalithic disturbance—due to the scattering of the red floor through the peaty accumulation above. But the evidence from Chamber 2, which was less disturbed, suggests that the two outer chambers may have been sealed originally with black and red packing.

For in this chamber the rifling—which took place at no very recent period—had left intact portions of black and red sealing. It must be admitted that even in Chamber 2 we have no proof of the original extension of this packing over the whole floor; it may have been placed around the walls only. In support of this possibility is the fact that the loose central filling of peaty soil contained very little admixture of red. And it is curious that no trace of original packing was found even along the side walls of Chamber 1, where the red floor was undisturbed.

The portions of black and red sealing found intact in Chamber 2 occupied the north-east side and the north-west end, against the sill dividing it from Chamber 3. The packing at the end contained a good many small stones; it was firmly set and had every appearance of being undisturbed. Against the side wall the material was similar but less stony. Here, on the cross-section cut (section 4), the round base of a pot (C) was found *in situ*, resting in the brown top of the red floor. A few flat stones lay on this floor, in places amounting to a continuous paving (fig. VI), and one centrally placed flag measured 18 ins. across. The material used for the black and red sealing was probably obtained from the immediate vicinity of the cairn, and would represent a mixture, perhaps accidental, of peaty topsoil and reddish brown subsoil.

Chamber 2 yielded only one sherd (from the black filling) in addition to the pot base mentioned above. The disturbed filling of Chamber 1 contained many fragments of pottery (B, D),

We have hinted that the outer "chambers" may have served as a passage leading into the inner burial chambers. There is no septal slab between them—an omission difficult to explain in any other way. Both the red floor and the underlying subsoil are quite uninterrupted in the neighbourhood of the jambs. Now the two existing sills are distinguished from the other megalithic components of the monument by being sunk well into the subsoil. The clean red floor comes neatly up against them, and they must therefore have been placed in position before the spreading of this floor. It is clear that if there had ever been a sill between Chambers 1 and 2 the exceptionally colourful soil section would have revealed its location.

In the absence of a supporting septal slab the jambs between Chambers 1 and 2 were well packed with boulders, sunk into the red. One of the jambs penetrated slightly into the subsoil, but careful observation showed that, like all the other jambs, it had been placed in position after the red was laid down. So also had all the side walls of the megalith; the sills alone were erected before the spreading of the red floor.

THE INNER CHAMBERS.

The black peaty filling formed a deep regular layer in Chambers 3 and 4. The earth floor underneath was undisturbed and paved in places, but by no means continuously. Chamber 4 had a fair pavement in the southern angle. The "upper brown" as marked on the sections differed from that observed above the red elsewhere. It was peaty in nature, but we attach no importance to this difference; the red floor is more or less impermeable and this chamber was much wetter than the others. Under these conditions peat would naturally tend to accumulate once the roof had gone.

One find only was made in Chamber 4—a flint flake which came from a pocket of red-flecked soft earth among the black filling 2 ins. above the pavement. This pocket was 10 ins. across, and it probably represents the spoil from a small area of disturbance in front of the sill, where the red floor had been dug into. Not a scrap of bone or pottery was discovered; if there had ever been any burials or funerary vessels it seems probable that all must have been removed before the destruction of the roof allowed vegetation to grow inside.

In Chamber 3 very few flooring stones were found, but the central area had many small rounded stones lying on or in the red earth. The only archaeological relics were fragments of pottery from near the surface of the black filling (F).

PORTAL AREA.

The tops of both portal stones had been broken and the southern (No. 1, south) is leaning and resting on its neighbour. Originally there would have been a gap of 18 ins. between them. The red floor continued unbroken through the portal into the forecourt, over most of which it was covered by cairn. The lower courses of the cairn consisted of large stones bedded in brown clay; an occasional flag lay on top of the red under this, but there was no regular or continuous pavement.

The red and black filling of Chamber 1, some 18 ins. deep, also continued through the portal and extended beyond for a yard or so, the solid cairn being absent here over a roughly semi-circular area immediately in front of the portal. The precise limit of the stone cairn in the portal area could not be determined everywhere owing to later disturbance caused by the smashing and collapse of all the four stones adjoining (1, 2; north and south), but its approximate line is shown on the plan. Clearly if the cairn had ever extended up to the portal it had at some period been removed and the black and red sealing put in its place. It is difficult to prove whether the area of black and red is of a later *period* than the cairn or whether it is contemporaneous, but the sections cut show that the cairn was laid down first. The surface of the red in the portal area was noticed to be uneven as though bearing the impressions of large stones, but even the presence of an occasional stone bedded in the red did not convince us that the cairn *had* at one time occupied the area.

The black and red sealing would appear to be related to the similar material found undisturbed in Chamber 2, and it is natural to suppose that it was put in position at the same time, that is when the monument was finally closed. An unusual feature is the presence of two holes or pits, sunk into the red floor in the cairn-free portal area. These are marked A and B on

the plan, and it will be seen that they are placed, respectively, opposite the north and south portal stones. Pit A is shown on section 6. Pit B was similar in every way, so far as could be made out in the disturbed stratification due to the collapse of the two adjoining uprights, and we will confine our description to Pit A. The diameter was 1 ft., the mouth nearly a true circle, the walls almost vertical, the depth 1 ft. The hole had been sunk through the red floor and the subsoil and into the rock to a depth of some 3 ins. Its investigation was comparatively simple owing to the clear colouration of the layers through which it was cut, and to the sharp differentiation of its speckled (black and red) filling, which was continuous with the filling of the whole portal area. Neolithic potsherds were found at all levels in this filling, from near the surface down to the bottom of the pit. A flint flake was also discovered close to the wall of the pit. The pottery fragments found, and also others discovered in Pit B. belong to a pot (A1) of which many more pieces were obtained both from the base and from the brown clay of the forecourt cairn. Soil from the wall of Pit A was very kindly tested by Professor T. Walmsley, but gave no indication of contamination by (for example) the blood of a possible sacrificial deposit.

The pits have the appearance of post holes, but if posts had been erected in them they must have been removed before the black and red sealing was placed in the portal area.

A third pit (C), of exactly similar nature, was found near the front of the forecourt on the line of the frontal peristalith and also on the axis of the chambers. This pit was covered, however, by the ordinary clay-set forecourt cairn, which was overlain, in this area, by an Early Iron Age occupation layer. It is natural to assume that all three pits are of the same age and therefore to suppose that the cairn was never built in the portal area, a conclusion which we had tentatively reached before the discovery of the third pit.

The location of pit C suggests that it may have been used in fixing the lay-out of the cairn after the spreading of the red floor,

CENTRAL AREA OF FORECOURT.

The monolith standing in the centre of the forecourt presents further problems. Excavation around it was complicated by the awkward position of a large broken portion which lay semi-detached on one side (section 7). The stone was sunk through the red into the subsoil, but on the south side the red was missing altogether, as described above.¹ We are faced with the problem which presented itself at one stage of our investigation of the portal area—the difficulty of deciding whether we are dealing with an original feature or with a later disturbance. On the north side the red layer is cut through close up against the stone. On the other sides a wide circular area is occupied by fairly solid cairn, which is set, however, not in brown clay but in red and black earth. The junction shown on the section (no. 7) proves that this supporting material was placed in position after the construction of the true forecourt cairn, but it is difficult to see why the same brown clay was not used if no long interval of time had separated the sealing of the forecourt from the erection of the monolith. On the other hand the filling of the portal area was of a similar character (although the set stones were absent here); and in support of the megalithic dating we can at least say that nothing demonstrably post-neolithic was found in the black and red material either in the portal area or around the monolith. It seems probable that the monolith was erected as a final act at the time when the portal was closed.

EARLY IRON AGE OCCUPATION LAYER.

A black habitation layer, rarely more than an inch thick, was revealed above the cairn and some 6 ins. below the turf at the end of the south horn, extending for 8 ft. from stone no. 6 (see plan). A fairly continuous stratum of small stones sealed the habitation earth, which yielded nothing besides fragments of an Early Iron Age pot (E1). Pieces of similar ware were found also at high levels in other parts of the forecourt, e.g. in the excavated area opposite stones 4 and 5 (north). Here they were accompanied by sherds of pure Neolithic character.

¹ The absence of the red in this area, however, would seem to have no real connexion with the position of the monolith.

THE FINDS.

The amount of pottery found at Browndod and the number of pots identifiable was smaller than at Ballyalton (fig. VIII). Owing to the disturbed condition of the chambers nearly everything came from the forecourt. Sherds occurred here in all strata, in the foundation layer of red earth, on it, in the brown clay which formed the packing of the lower part of the cairn-bank, in the speckled areas in front of the portals and round the monolith, and at high levels near the surface and so above the cairn-bank which sealed the entrance. They were commonest, however, near the portals. The few embedded in the red platform must be regarded as intrusive, as they belong to a pot the greater part of which was found at a higher level. Details of finds have been deposited in Belfast Museum.

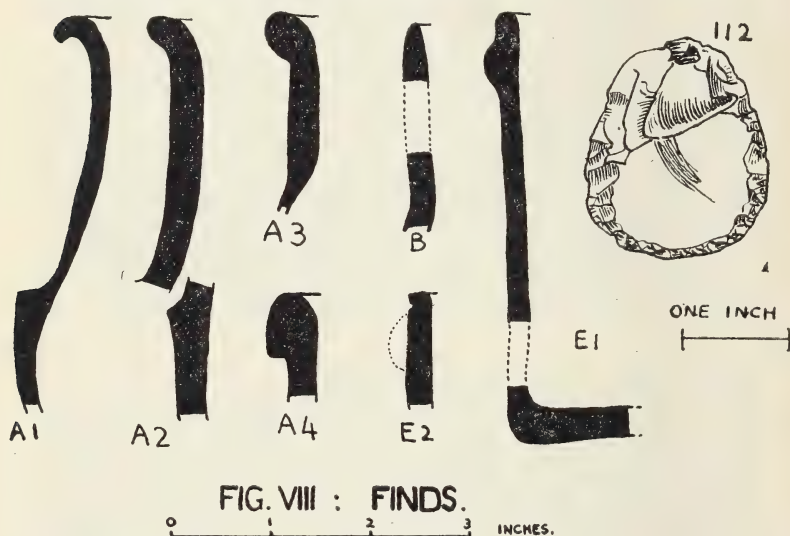


FIG. VIII : FINDS.

Most of the sherds belonged to red bowls with rim bent outwards but not rolled, relief shoulder, and surface hand-smoothed and moderately pebble-polished. The shoulder was pinched out, the neck just below the rim was smoothed with the thumb in bending the rim over. It is almost certain that two pots are represented, from the variations in the thickness and height of the neck and in the contour

of the rim and shoulder; but it has not been possible to sort out the sherds into two groups with certainty. In particular, the base of A1 seems to have been as thick as the neck of A2, so that it has been impossible to ascribe any fragments of base to the latter. A large part of A1 has been recovered; the rest presumably lies buried under that part of the cairn-bank which was not excavated.

A1. Sherds apparently from this pot were found in all parts of the forecourt, even at the base of both the pits in front of the portals (see section 6). The pot is a graceful bowl, with walls fairly even, rim curved outwards, and shoulder fairly well pronounced. The diameter was about 20 cms. The thickness of the neck is 5-6 mms., the height of the neck 6 cms. The base appears to have been rounded. Near it the outer surface is blackened as if the pot had stood on a fire, while inside in the corresponding position there are stains and a ring of black greasy soot, such as is common on cooking-pots. This bowl is, however, too fine to have been used for domestic purposes, so probably a sacrifice was prepared in it and it was then broken, some of the pieces being left on the red floor, while others were thrown into the cairn-bank.

A2. Sherds of this bowl were found at all levels. It must have closely resembled A1, save that the surface is coarser and the rim less graceful. The shoulder is less pronounced. The height of the neck was more than 7 cms., its thickness 7-8 mms. It is not thinned out just above the shoulder in pinching the latter out, as is A1.

A3. The amount of this pot recovered is very much less than of the two previous ones. It appears to be due to chance that all the sherds identified as belonging to it save one came either from a high level or from a disturbed area. The surface is black and finely pebble-polished, the biscuit grey. The rim is cylindrical in section, having been apparently bent over and slightly thickened. The neck is 8 mms. thick just below the rim, but about 4 cms. down it is thinned down to 3 mms., having been apparently pinched out to form the shoulder. Of the latter no fragments remain, but it appears to have been of the usual relief type. The base was probably round. The diameter of the pot must have been at least 15 cms. It seems therefore to have been a bowl resembling A1 and A2, but with rather more developed rim.

A4 consists of three pieces of a thick and heavy rim 1½cms. high, slightly polished, red-brown on the outside and black on the inside. The neck is 8 mms. thick. No other fragments of this pot are identifiable. The shape and fabric appear to be neolithic, though they cannot be precisely paralleled; the stratigraphical evidence for the date is inconclusive, as one piece was found in the interlocking cairn-bank but above the brown clay which sealed the lower part of its contents, while the other two, which fitted together, came from the speckled area of the pits.

These pots differ slightly from those found at Ballyalton. The surface is less finely polished, the shoulders constructionally form part of the pot whereas at Ballyalton the pointed shoulders marked the top of the body while the neck was attached separately, and the rims are simple and unsophisticated whereas at Ballyalton they had become flattened with ripple ornament. We are justified in describing the Ballyalton pottery as later than that from Browndod, not only on stylistic grounds, but because the former site also yielded coarse sherds with much ornament reminiscent of Peterborough motives. Parallels to the heavy rim H at Ballyalton were found at the Dundrum sandhills with the maggot-ornament characteristic of the Peterborough culture. At Browndod there were no Peterborough elements, and none of the neolithic pots was in any way ornamented. It therefore forms a pure example of the north-western neolithic group. In this respect it is akin to the few neolithic sherds from Goward. A3 is identical with Goward VI, and the relief-shoulder on A1 is similar to Goward II and IV (cp. *Proceedings* of the Belfast Natural History Society, 1932/3, 90). The Browndod pottery is also closely allied to sherds found at Mull Hill (Isle of Man) (Piggott, *Antiquaries Journal*, 12, 1932, 146) and at Glenluce (Wigtownshire) (Callander, *Proceedings* of the Society of Antiquaries of Scotland, 63, 1928/9, 29).

In addition to those discussed, the forecourt yielded a few coarse unidentifiable fragments. Apparently three pots are represented; they appear to have been domestic ware, and one piece had soot on the outside.

Chamber 1 had been almost entirely rifled, but the pots in it appear to have been broken, and small fragments of two were recovered. B is represented by two sherds of

fairly fine pebble-polished ware, reddish-brown on the surface and through the biscuit, and 6-7 mms. thick. One piece is part of a neck immediately above a relief-shoulder. The other is a plain rim, slightly curved vertically, as if the pot had had a spout.

C is the only pot from Chamber 2. It was found set upright at the base of the sealing layer at the north side of the chamber, resting on and slightly into the brown earth which seems to form the surface of the red platform; it may therefore be *in situ*. It contained black earth with some charcoal and pottery fragments, probably from its neck. Unfortunately only the rounded base remains (fig. IX); it has been broken off fairly evenly at about $5\frac{1}{2}$ cms. height. The walls rise almost vertically, the maximum present diameter being 10 cms. The pot is slightly asymmetrical. The clay is coarse and gritty, 7-8 mms. thick. The inner surface is fairly even, and shows marks of a smoothing instrument, either a stick or a brush. The outer surface is cracked, as if the pot had been badly dried. The colour is yellow-brown, and just below the surface yellow, giving way to grey-black in the interior.

D consists of 15 shapeless sherds from Chamber 1. The ware is coarser than B, the thickness 9-10 mms. The clay contains some pebbles. The outer surface is fairly smooth and red, unpolished. The inner surface is dark-coloured, perhaps slipped, with marks which appear to be those of a brush; it has the appearance of having been made on a mould. These technical peculiarities may suggest that the pot is intrusive. The fact that some of the sherds were found on and in the red platform does not disprove this, since there has been so much disturbance in the chamber.

E1. At a high level in the forecourt there were found several pieces of an Iron Age pot. They were mainly associated with a layer of dark habitation earth between the monolith and the southern horn, but a few pieces had been scattered more widely, one being found near the northern horn. The vessel was a red or brown cooking-pot, largely covered with soot both inside and outside. It is very uneven. The thickness of the walls is about 9 mms. The baking was irregular; the sides are hard and have a good surface, the flat base is crumbly and inclined to crack, especially on the lower side. The rim is uneven and

undecorated. At a mean distance of 2 cms. below it is an unornamented applied strip; the junction with the walls of the pot was smoothed over with the thumb. The height of the pot is indeterminable, but more than 8 cms.; the internal diameter was 22 cms.

E2 is a fragment of rim apparently from a different pot from E1. It was found outside the forecourt, near the horn-stone S6, and where the peristalith should have been. The rim is uneven and undecorated, about 6 mms. thick. About 1 cm. below it was an applied band, which has disappeared.

These two pots are of the common Iron Age type known as souterrain pottery. An exact chronology for this ware has not yet been worked out. The applied band below the rim is usually decorated with finger-tip or other ornament; undecorated it has been found at Kilbride souterrain and Ballintoy, and this feature may indicate a late date. The presence of this pottery does not date the monument to the Iron Age; it clearly belongs to a reoccupation period. It appears that part of the forecourt was inhabited; probably a tent was stretched from the southern horn-stones. Something similar seems to have happened at Goward, though there Iron Age pottery was found also inside the chambers.

F. Near the surface of Chamber 3 there were found a few fragments of a rounded rolled rim, yellow and about 1 cm. in diameter. The clay was very lightly baked, hardly more than dried, and is fragile and crumbly. The shape could be neolithic, in which case the pot must have reached its level owing to subsequent disturbance. Embedded in one piece was a root, which might have forced its way in. In another was something declared by Miss Lynn to be modern casing of a beech bud. The pot can hardly be so modern, but it is difficult to see how this object reached its position unless it was dragged by an insect.

The only piece of metal found was a horseshoe which had been placed beneath the pointer-stone, perhaps at the time that it was broken. This illustrates the continued belief in the sanctity of megalithic monuments, a belief which has preserved for us much that would otherwise have been destroyed.

The flints were uninteresting. Flakes were found in Chamber 2 and in a pit in the filling of Chamber 4.

In Chamber 3 were several lumps of flint, one of which may have been a rough core. The forecourt was more productive; many of the pieces are of a fine glassy flint which often splits rectangularly. Five flakes of this flint were found on the red platform, one in the disturbed area near the pointer-stone, and one or two on the surface. Two pieces further had semi-circular hollows, and were probably used as scrapers, though secondary working was not visible; one of these came from the upper part of the cairn-bank, another from the east edge of the northern pit in front of the portals. Another flint from a high level in the forecourt is perhaps a piece of a hollow scraper. A square flake may have been slightly retouched at one end to make a scraper. In addition there were three flakes doubtfully artificial, and a conical nodule much battered near the point and perhaps used as a hammer-stone. The forecourt also yielded three rounded yellow pebbles, perhaps deposited for votive purposes.

A few flints were found at the edge of the cairn, where they may or may not have been purposely deposited. The best scraper (fig. VIII, 112) came from outside the horn to the south-east of the pointer-stone. It is piriform, $5\frac{1}{2} \times 4\frac{1}{2}$ cms., made of a rough flake of inferior flint retouched at the butt and partially along the sides. A flake which may have been worked to a hollow scraper was found in the northern part of the ring of stones enclosing the forecourt beyond the horn. Another flake which has been slightly retouched along one side to form a rough knife was turned up in the middle of the north side of the cairn.

No bones of any sort were discovered.

Specimens of charcoal were numerous. Pieces found in the brown till below the red pavement, and consequently earlier than the monument, were said to be probably hazel in the forecourt and hazel or alder in Chamber 3. Pieces from the top of the red pavement and so contemporary with the period of occupation of the monument are hazel (*Corylus* sq.) hazel or alder (*Alnus* sp.), and elm (*Ulmus* sp.). From this level in Chamber 2 there were also doubtful specimens of willow (*Salix* sp.) and oak (*Quercus* sp.). In the Iron Age occupation layer there was ash (*Fraxinus* sp.). The charcoal specimens have been most kindly examined by the Forestry Products Research Laboratory at Princes Risborough.

ANALYSES OF IRISH SOCKETED CELTS.

By O. DAVIES.

By the kindness of the Curator of the Belfast Municipal Museum, I have been able to analyse five broken socketed celts, (a)—(d) from the Grainger Collection and (e) from the Benn Collection. In no cases are the find-spots known, but both these collections were formed almost exclusively in Co. Antrim, so it may be taken as probable that all five came from N.E. Ireland.

- (a) 6.138/3898. Squarish socket, blade much curved, $4\frac{3}{4}'' \times 2\frac{1}{2}''$.
- (b) 6.132/3898. Squarish socket, descending very nearly to the blade, $3\frac{1}{4}'' \times 1\frac{3}{4}''$. Type degenerate. Metal rather rusted, in parts greyish, with a crack down one side.
- (c) 6.140/3898. Square socket, with three ribs on surface ending in concentric knobs, $4\frac{3}{4}'' \times 2''$. Mr. E. E. Evans considers the type Breton. Metal light yellow, slightly rusted on the surface, not well cast.
- (d) 6.134/3898. Round socket, unornamented and looped, $3\frac{1}{4}'' \times 2''$, typical of the latest Bronze Age in Ireland. Rather rusted and brittle.
- (e) 1911.160. Squarish socket, probably looped, ornamented with three ribs on the surface, $3\frac{1}{2}'' \times 1\frac{3}{4}''$. Metal reddish and rather rusted.

	Cu	Sn	Pb	Sb	Zn	Fe	Ni	Ag	Bi	As	Co
(a)	77.92	.01	3.05	5.63	2.14	.52	none	none	.43	none	none
(b)	much	3.2	29.95	.16	1.37	.67	tr.	none	none	none	none
(c)	75.49	16.0	1.81	.18	.97	.13	tr.	none	none	none	none
(d)	79.46	3.48	1.87	5.35	none	.19	.5	none	none	none	none
(e)	74.11	1.1	7.7	5.65	none	.15	tr.	tr.	none	none	none

The low tin percentage shows that this metal was expensive or unprocurable; on the other hand, (c), which is not of local type, contains a great deal of tin, which occurs, and was almost certainly exploited in the Bronze Age, in the Josselin massif and other parts of Brittany⁽¹⁾.

(1) De Limur, Bull. Soc. polymathique de Morbihan, (1878) p. 124, (1893) p. 68; Kerforne, Inst. finistérien d'Etudes préhistoriques, Musée de Penmarc'h, Bulletin et Mémoires, ii/iv (1924/6); Marseille, C. R. Ass. française pour l'Avancement des Sciences, (1922) p. 517.

This celt must therefore be regarded as an ancient import, unless it was bought abroad. Previous analyses of Irish objects of the Late Bronze Age have shown a fairly large amount of tin; but practically none that have been tested were certainly found in Ulster, none north of Belfast Lough.

The shortage of tin made it necessary to use substitutes, lead (a) (c) (d), antimony (a) (d) (e), and perhaps zinc (a) (b), all of which may have been obtained locally. Some lead, but not usually more than 3%, has been found in many Late Bronze Age objects from Ireland⁽²⁾, and is a common constituent throughout western Europe, as except in large quantities it harms only bronzes which need special temper, such as swords. The large amount of lead in (b) shows that this celt was votive, and connects it with those of Brittany⁽³⁾, though the alloy is also found in Spain⁽⁴⁾, Normandy⁽⁵⁾, and Belgium⁽⁶⁾.

A zinc alloy has never been found in the Late Bronze Age in W. Europe. The absence of this metal in (d) and (e) suggests that it was not an ore impurity in (a)—(c). It may have been introduced with scrap metal by the founder, or with the lead, in conjunction with which it often occurs naturally⁽⁷⁾.

Antimony-bronze is unknown in Ireland, save perhaps for a lump of metal of unknown provenance⁽⁸⁾. A high percentage of antimony occurs in Portugal, with much lead⁽⁹⁾, occasionally in the Loire valley⁽¹⁰⁾, and at a later date in Alsace⁽¹¹⁾, but is commoner in the Bronze Age of Central Europe, as this alloy emanated from the metallurgical site of Velem Szent Vid in West Hungary. But

(2) Evans, *Bronze Implements of Great Britain*.

(3) Marsille, *Bull. Soc. polymathique de Morbihan*, (1913/21) *Mém.* p. 49.

(4) Siret, *Questions de Chronologie et d'Ethnographie ibériques*.

(5) Chantre, *L'Age du Bronze*.

(6) Jacobsen, *L'Age de Bronze en Belgique*.

(7) Cp. Meyer, *Gurina in Obergailtal*.

(8) Sullivan *ap.* O'Curry, *Manners and Customs of the Ancient Irish*.

(9) Siret, *l.c.*

(10) Gabeau, *Bull. Soc. archéologique de Touraine*. xi, p. 114; Dubreuil-Chambardel, *La Touraine préhistorique*.

(11) Forrer, *Zs. f. Ethnologie*, (1909) p. 458.

there is a fair amount of it in a celt of early date found at Pile (Schonen, South Sweden)⁽¹²⁾, which is typologically English; further, this tool agrees moderately well in impurities with the objects under discussion, with a low nickel percentage, though it also contains a little arsenic.

The character of the impurities is fairly constant, and probably indicates a common source for the copper. In (a) there is a little bismuth, in the others traces of nickel, silver is usually absent, and there is no arsenic cobalt or bismuth; the ore probably contained no zinc, but the small quantities of antimony in (b) and (c) make it probable that this metal was found in the ore as well as being added as an alloy. For the presence of bismuth no parallel can be adduced, as this impurity is seldom tested. Otherwise the metal resembles one Irish tool⁽¹³⁾, though this is a tin-bronze, and more doubtfully three others⁽¹⁴⁾. The usual Southern Irish material is however distinct, as it nearly always contains arsenic. Nickel also occurs with occasional traces of silver but without antimony in Late Bronze Age objects containing a good deal of lead from Wales and England⁽¹⁵⁾. The source of the ore cannot at present be determined owing to lack of analyses, but it appears that, as in the neolithic and probably the proto-historic period, N.E. Ulster was in the Late Bronze Age economically linked with England rather than with S. Ireland and Cornwall.

(12) Montelius, *Chronologie der ältesten Bronzezeit*.

(13) So-called socketed chisel from Newry. Wilde, *Catalogue of Royal Irish Academy Museum*.

(14) Probably Irish stop-celt, Armstrong, *Man* (1926) 105. Two in Evans, *Bronze Implements*, with copper 83.65% and 90.69%.

(15) Celt from Cerigwey-Druidion (N. Wales), Knapp, *Ann. Chemie und Pharmacie* (Wohler & Liebig) lviii (1846) p. 104. From England, celt from Yorkshire and dagger from Newton (Evans, *Bronze Implements*); a number from the Willow Moor hoards (Salop) (Chitty, *Antiquaries Journal* (1928) p. 30); socketed celts from Driffield and Everthorpe (Yorks) (Armstrong, *l.c.*).

EDUCATIONAL ENDOWMENTS (IRELAND) ACT, 1885.

The Account of Belfast Natural History and Philosophical Society for the year ended 31st October, 1935.

Dr.

Cr.

RECEIPTS.		PAYMENTS.	
To Subscriptions ...	£82 10 0	By Balance as per last Account ...	£54 8 11
„ Dividends ...	13 19 0	„ Rent, Rates, Taxes and Insurance ...	47 17 8
„ Rents ...	137 12 1	„ Printing and Stationery ...	90 3 2
„ Miscellaneous Receipts, viz. :—		„ Salaries and Wages ...	47 19 9
Archaeological ...	£26 7 0	„ Advertising ...	17 2 9
Nendrum Books ...	1 0 6	„ Fuel and Light, Gas, Electricity, etc. ...	8 4 4
Periodicals ...	1 11 6	„ Other Payments, viz. :—	
Essay ...	1 7 6	Archaeology ...	£62 4 4
R. S. Lepper, M.A. ...	16 0 0	Lectures, etc. ...	54 3 9
„ Balance due Bank ...	46 6 6	Dr. Farrington—Grant ...	15 0 0
„	145 18 8	Lanterns ...	6 0 0
		Postages ...	11 0 0
		Cheque Book, Bank Interest and Charges ...	6 10 0
		Sundries ...	1 10 7
		Audit Fee ...	1 1 0
		Irish Naturalists' Journal ...	3 0 0
			160 9 8
			£426 6 3

We certify that the above is a true Account.

I certify that the foregoing Account is correct.

E. J. ELLIOTT, Governor.

W. R. MACONKEY,

W. B. BURROWES, Accounting Officer.

Comptroller and Auditor-General.
17th day of February, 1936.

EXCHANGES.

- ABO—Publications of the Abo Academy.
ALBANY—Bulletins of the New York State Museum.
ANN ARBOR—Publications of the University of Michigan.
ATHENS—Publications of the Zoological Institute and Museum.
AUCKLAND—Reports of the Auckland Institute and Museum.
BASEL—Verhandlungen der Naturforschenden Gesellschaft in Basel.
BERGEN—Publications of the Bergen Museum.
BERKELEY, CAL.—Publications of the University of California.
BIRMINGHAM—Publications of the Birmingham Natural History and Philosophical Society.
BLOEMFONTEIN—Publications of the National Museum of South Africa.
BOLOGNA—Rendiconto R. Accademia delle Scienze di Bologna.
BOSTON—Publications of the Boston Society of Natural History.
BOULDER—Publications of the University of Colorado.
BRIGHTON—Annual Report of the Brighton and Hove Natural History and Philosophical Society, 1935.
BRUSSELS—Annals Societe Royale Zoologique de Belgique.
„ Bulletin Societe Royale de Botanique de Belgique.
BUENOS AIRES—Anales Museu Nacional de Historia Natural.
BUFFALO—Bulletins of the Buffalo Society of Natural Sciences.
CALCUTTA—Publications of the Geological Survey of India.
CAMBRIDGE, MASS.—Publications of the Museum of Comparative Zoology.
CARDIFF—Transactions of the Cardiff Naturalists' Society.
CHICAGO—Publications of the Chicago Academy of Sciences.
CINCINNATI—Bulletin of the Lloyd Library.
COIMBRA—Publications of the Zoological Museum of the University of Coimbra.

COLORADO SPRINGS—Publications of the Colorado College.

COLUMBUS—Ohio Journal of Science.

COVENTRY—Proceedings of the Coventry Natural History and Scientific Society.

DANZIG—Schriften Naturforschenden Gesellschaft.

DUBLIN—Proceedings of the Royal Dublin Society.

EDINBURGH—Proceedings of the Royal Physical Society.

„ Proceedings of the Royal Society of Edinburgh.

„ Transactions and Proceedings of the Botanical Society of Edinburgh.

„ Proceedings of the Society of Antiquaries of Scotland.

EXETER—Proceedings of the Devon Archaeological Exploration Society.

GLASGOW—Proceedings of the Geological Society of Glasgow.

GORLITZ—Publications of the Natural History Society of Gorlitz.

GOTEBORGS—Handlungar Regia Societas Scientiarum et Literarum Gotoburgensis.

HALIFAX, N.S.—Proceedings of the Nova Scotian Institute of Science.

INDIANAPOLIS—Proceedings of the Indiana Academy of Science.

LA PLATA — “Manuferos Fossiles de la Republica Argentina.”

LAUSANNE—Memoirs and Bulletins de la Societe Vaudoise des Sciences Naturelles.

LAWRENCE—Bulletins of the University of Kansas.

LIMA—Memorias Sociedad de Ingenieros del Peru.

LONDON—Quarterly Journal of the Royal Microscopical Society.

„ Publications of the British Association.

„ Proceedings of the Royal Institute of Great Britain.

„ Quarterly Journal of the Geological Society.

„ Publications of the British Museum (N.H.).

„ Publications of the Viking Society for Northern Research.

MADISON—Transactions of the Wisconsin Academy of Sciences, Arts and Letters.

MELBOURNE—Proceedings of the Royal Society of Victoria.
 MONTEVIDEOA—Archivos Sociedad de Biologia de Montevidea.
 MOSCOW—Bulletin de la Societe des Naturalistes de
 Moscow.

NEWCASTLE, TYNE—Proceedings of the University of Durham
 Philosophical Society.

NEW HAVEN—Memoirs of the Connecticut Academy of Arts
 and Sciences.

OSLO—Arbok Academie Norvegieme des Sciences et des
 Lettres.

„ Publications of the University Library, Oslo.

OTTAWA—Publications of the Geological Survey of Canada,
 Department of Mines.

„ Publications of the Canadian Dept. of Agriculture.

OXFORD—Proceedings and Report of the Ashmolean
 Natural History Society.

PHILADELPHIA—Proceedings of the Academy of Natural
 Sciences of Philadelphia.

„ Proceedings of the American Philosophical
 Society.

POLSKA—Annales Panstevowe Museum Zoologiczne.

RENNES—Bulletin Geologique et Mineralogique de Bretagne.

RIGA—Publications of the Latvijas Universitates, Riga.

RIO DE JANEIRO—Archivos Botanico do Rio de Janeiro.

„ Publications of the National Museums of
 Brazil.

„ Publications of the Oswaldo Cruz
 Institute.

ROCHESTER, N.Y.—Proceedings of the Rochester Academy
 of Science.

SAN DIEGO—Transactions of the San Diego Society of
 Natural History.

SAN FRANCISCO—Proceedings of the California Academy of
 Sciences.

STIRLING—Transactions of the Stirling Natural History and
 Archaeological Society.

ST. LEONARDS-ON-SEA—Report of the Hastings and St.
 Leonards Natural History Society.

ST. LEONARDS—Hastings and East Essex Naturalist.

STRATFORD—The Essex Naturalist.

STRAVANGER—Arshafte Stravanger Museum.

SWANSEA—Proceedings of the Swansea Scientific and Field Naturalists' Society.

SYDNEY—Annual Report of the Technological Museum, 1935.

TORONTO—Transactions of the Royal Canadian Institute.

TORQUAY—Transactions and Proceedings of the Torquay Natural History Society.

UPSALA—Bulletin of the Geological Institution of Upsala.

WASHINGTON—Annual Report of the Smithsonian Institution.

„ Publications of the Freer Art Gallery.

„ Proceedings of the United States National Museum.

„ Smithsonian Institution, Miscellaneous Collections.

„ Publications of the United States Geological Survey.

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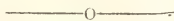
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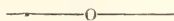
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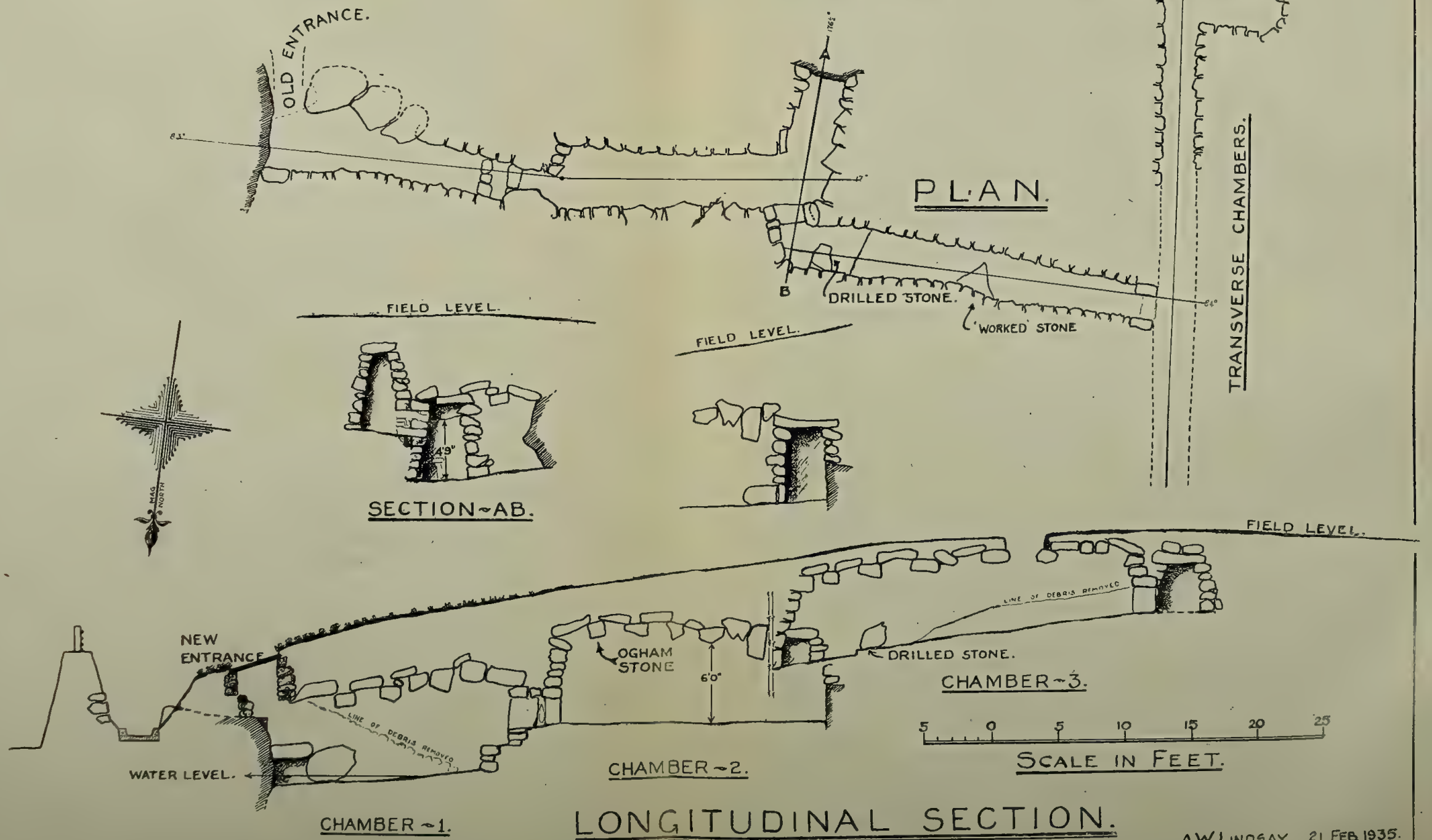


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18 NOV 1936

THE DUNALIS SOUTERRAIN AND OGHAM STONE.



A.W. LINDSAY. 21. FEB. 1935.



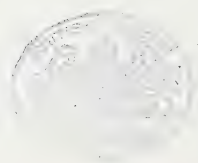


Fig. 1b.



Fig. 1a.

Dunalis Souterrain : Chamber No. 2.



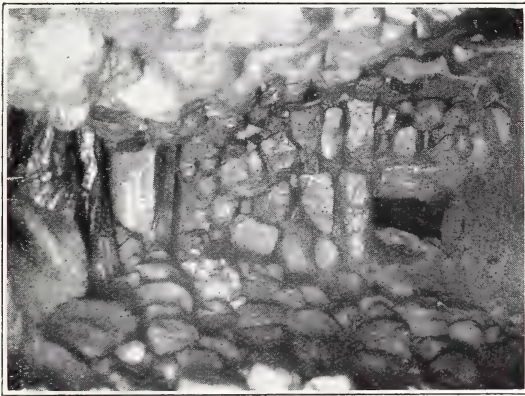


Fig. IIb.

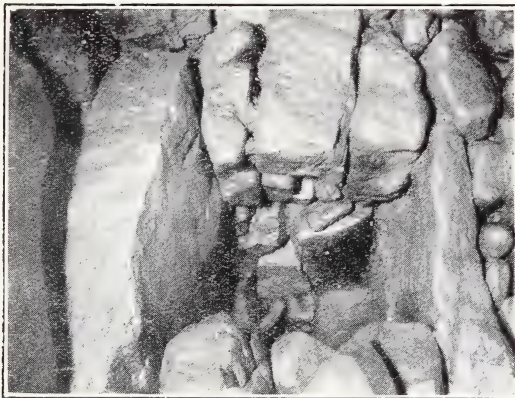


Fig. IIa.

Dumalis Souterrain : Chamber No. 2.





Fig. IIIa.

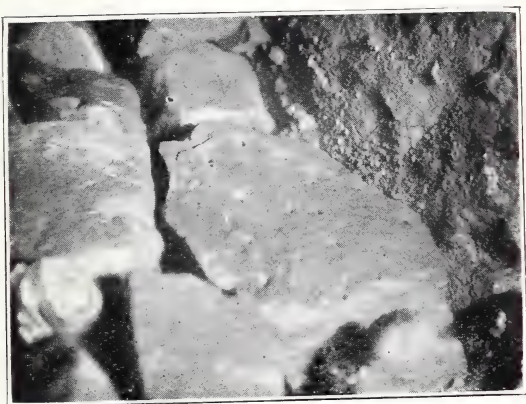


Fig. IIIb.

Dunalis Souterrain : Chamber No. 3.





Fig. IV.

Dunalis Souterrain ; Chamber No. 1.



Fig. VI.

Browndod. Pavement resting on prepared floor, Chamber II.





Fig. VII.
Brownlod. General view of chambers from rear.

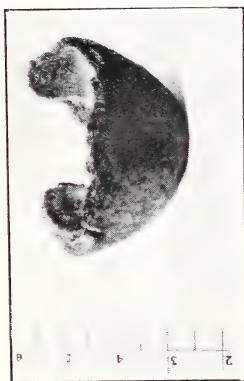
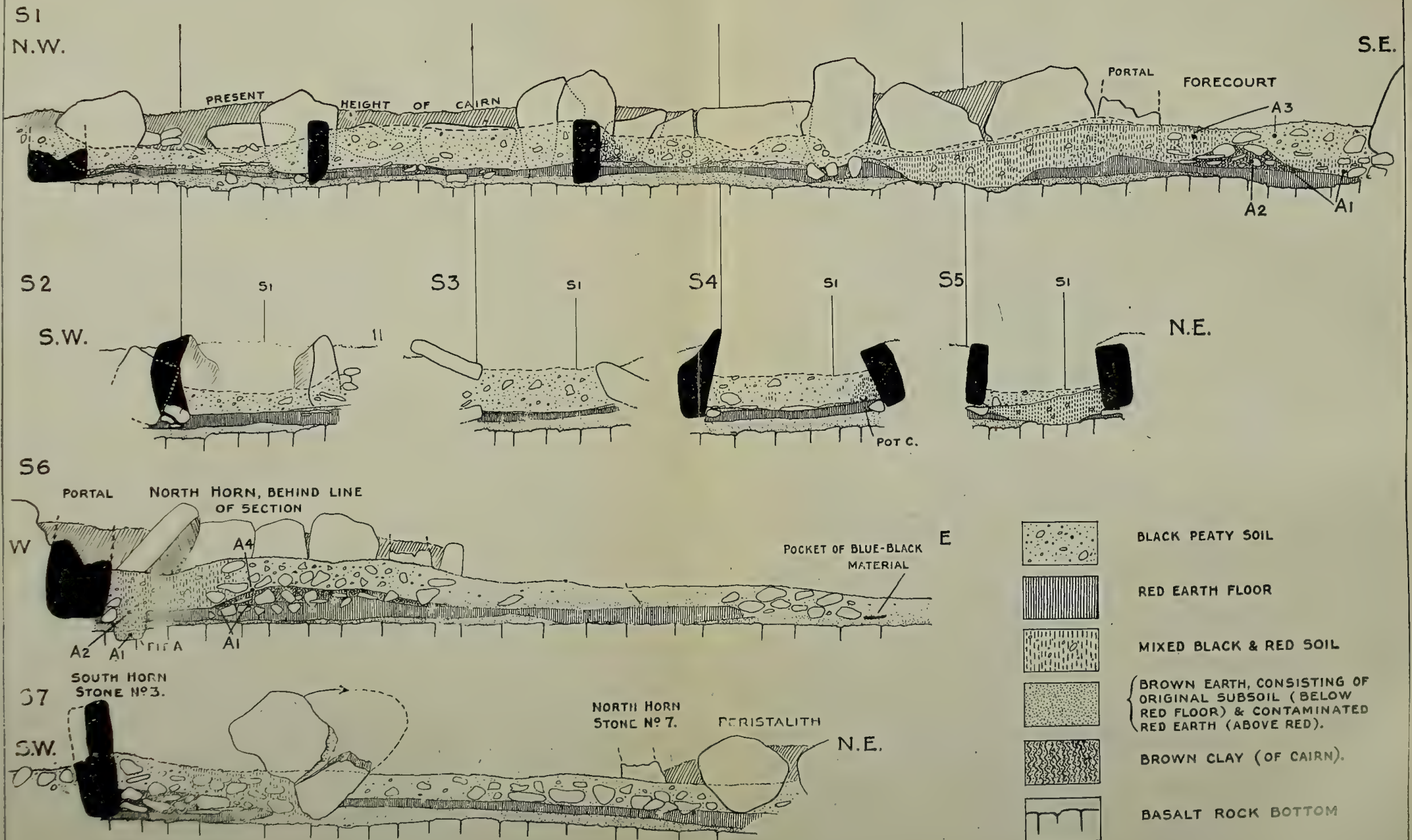


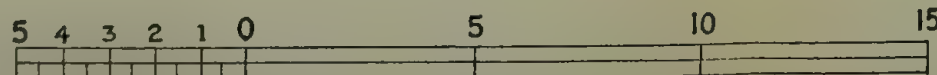
Fig. IX.
Pot C. Brownlod. Chamber II.



CAIRN AT BROWNDOD: SECTIONS.



SCALE of FEET



NOTE - SECTION 7 HAS BEEN DRAWN AGAINST THE FACE OF CENTRAL FORECOURT STONE.
LETTERS (A1,2,3&4) REFER TO SHERDS, SECTIONS 1 & 6.

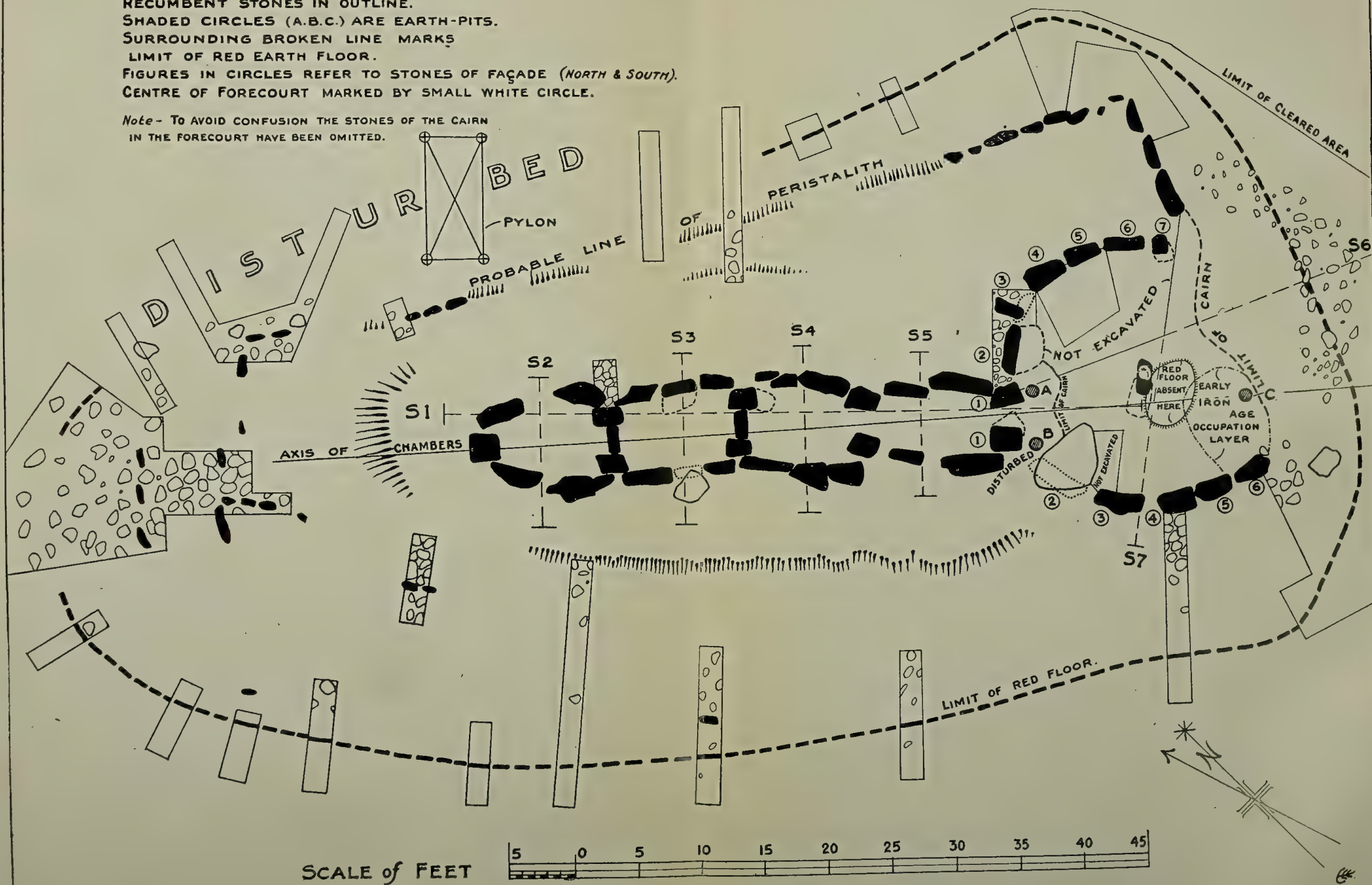
etc.



CHAMBERED HORNED CAIRN, BROWNDOD, Co. ANTRIM.
PLAN SHOWING AREAS EXCAVATED & SECTIONS DRAWN (SI-57).

UPRIGHT STONES IN SOLID BLACK.
RECUMBENT STONES IN OUTLINE.
SHADED CIRCLES (A.B.C.) ARE EARTH-PITS.
SURROUNDING BROKEN LINE MARKS
LIMIT OF RED EARTH FLOOR.
FIGURES IN CIRCLES REFER TO STONES OF FAÇADE (NORTH & SOUTH).
CENTRE OF FORECOURT MARKED BY SMALL WHITE CIRCLE.

Note - To AVOID CONFUSION THE STONES OF THE CAIRN
IN THE FORECOURT HAVE BEEN OMITTED.





$\frac{10}{1} pl$

